AD-A106 632 ARMY ENGINEER DISTRICT MEMPHIS TN F/G 13/13
NATIONAL DAM SAFETY PROGRAM. TURKEY CREEK DAMS (MO 31101, MO 31--ETC(U)
AUG 79 J L ANDERSON, H L SMITH, R O SMITH

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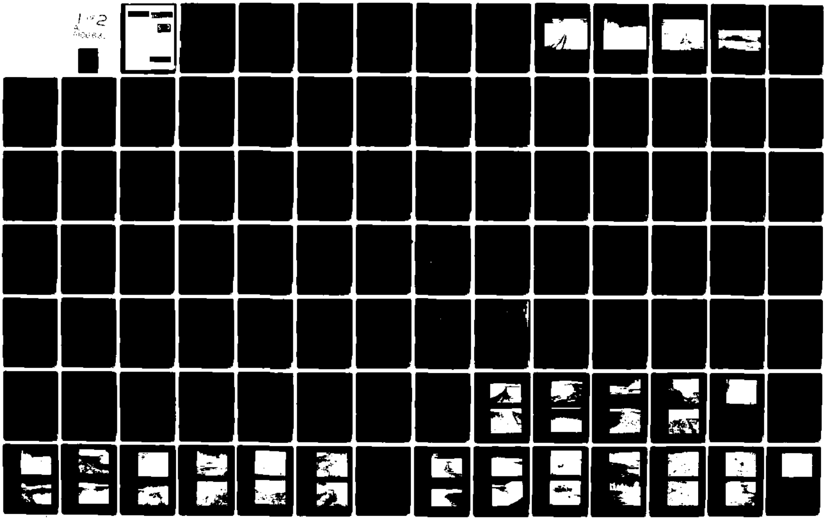

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National Dam Safety Program
Turkey Creek Dams (MO 31101, 31108, 31109, 31602)
Wayne County, Missouri

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Dam Safety, Lake, Dam Inspection, Private Dams, Lake Julia Dam, Lake of the Pines Dam, Turner's Dream Lake Dam, Lake Janna Dam.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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PHASE I REPORT
NATIONAL DAM SAFETY REPORT

Name of Dams	Lake Julia Dam Lake of the Pines Dam Turner's Dream Lake Dam Lake Janna Dam
State Located	Missouri
County Located	Wayne County
Stream	Unnamed Tributary to Barnes Creek
Date of Inspection	16 May 1979

Lake Julia Dam (Mo. 31101), Lake of the Pines Dam (Mo. 31109), Turner's Dream Lake Dam (Mo. 31108) and Lake Janna Dam (Mo. 31602) make up what are known as the Turkey Creek dams. The four Turkey Creek dams are presented in this Phase I inspection report because they act as a system both hydrologically and hydraulically.

The four Turkey Creek dams were inspected by an interdisciplinary team of engineers from the Memphis District, U.S. Army Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the four dams with respect to safety, based upon available data and visual inspection, in order to determine if the dams pose hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines the Turkey Creek dams acting as a system are in the high downstream hazard potential classification. Failure of the dams would threaten the life and property of approximately eight families downstream of the dams and cause appreciable damage to highway E which is 1.2 miles downstream of the dams. Individually, the Turkey Creek dams are classified as follows; Lake Julia Dam (Mo. 31101) is classified as a small size dam with a high downstream hazard potential. Failure of this dam would cause overtopping or failure of Turner's Dream Lake Dam (Mo. 31108). Lake of the Pines Dam (Mo. 31109) is classified as an intermediate size dam with a high downstream hazard potential. Failure of this dam would cause overtopping or failure of Turner's Dream Lake Dam (Mo. 31108). Lake Janna Dam (Mo. 31602) is classified as a small size dam with a high downstream hazard potential. Turner's Dream Lake Dam (Mo. 31108) is classified as a small size dam with a high downstream hazard potential. Failure of this dam would threaten the life and property of approximately eight families downstream of the dam and cause appreciable damage to highway E which is 1.2 miles downstream of the dam.

The inspection and evaluation of the above mentioned dams indicate that the spillways in each dam will not meet the criteria set forth in the guidelines for dams having the previously mentioned size classification and hazard potential. Due to the fact that failure of either Lake Julia Dam (Mo. 31101) or Lake of the Pines Dam (Mo. 31109), or failure of any combination of Lake Julia Dam (Mo. 31101), Lake of the Pines Dam (Mo. 31109) or Lake Janna Dam (Mo. 31602), will cause overtopping or failure of Turner's Dream Lake Dam (Mo. 31108), the spillway/spillways in each dam are required to pass the Probable Maximum Flood (PMF) without the dams being overtopped. Also, Turner's Dream Lake Dam (Mo. 31108) is required to pass the PMF, because failure of the dam would result in a high hazard potential to life and property downstream of the dam. The PMF is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

The emergency spillway for Lake Julia Dam (Mo. 31101) will pass only 9 percent of the PMF before the dam embankment is overtopped. Because the spillway will not pass 1/2 of the PMF without overtopping and will not pass the 10-year frequency flood without overtopping, Lake Julia Dam (Mo. 31101) is classified as "unsafe emergency".

The emergency spillway for Lake of the Pines Dam (Mo. 31109), will pass only 20 percent of the PMF before the dam embankment is overtopped. Because the spillway will not pass 1/2 of the PMF without overtopping but will pass the 10-year frequency flood, Lake of Pines Dam (Mo. 31109) is classified as "unsafe non-emergency". The spillway will pass the 100-year flood without overtopping, which is a flood that has a 1 percent chance of being exceeded in any given year.

The emergency spillway for Turner's Dream Lake Dam (Mo. 31108) will pass only 20 percent of the PMF before the dam embankment is overtopped. The spillway will pass the 100-year flood without overtopping. However, Turner's Dream Lake Dam (Mo. 31108) is classified as "unsafe emergency" due to the 10-year frequency flood overtopping and probable failure of Lake Julia Dam (Mo. 31101) which in turn could cause overtopping and failure of Turner's Dream Lake Dam (Mo. 31108).

The discharge structure for Lake Janna Dam (Mo. 31602) will pass only 25 percent of the PMF before the dam embankment is overtopped. The discharge structure for Lake Janna Dam (Mo. 31602) will marginly pass the 100-year frequency flood. Because the discharge structure will not pass 1/2 at the PMF but will pass the 10-year frequency flood, Lake Janna Dam (Mo. 31602) is classified as "unsafe non-emergency".

It is recommended that the owner take action to correct or control the deficiencies described. Corrective works should be in accordance with analyses and design performed by an engineer experienced in the design and construction of dams.

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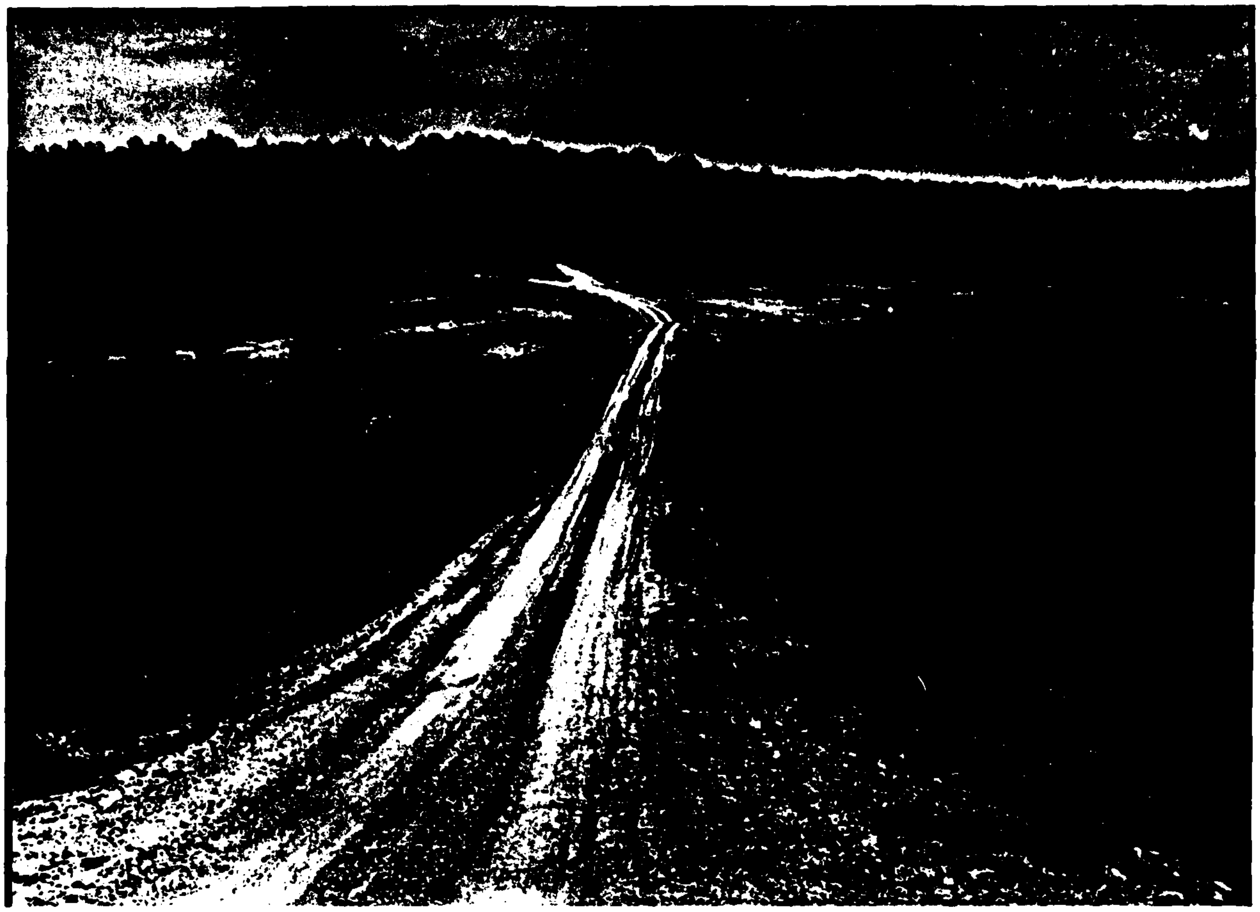
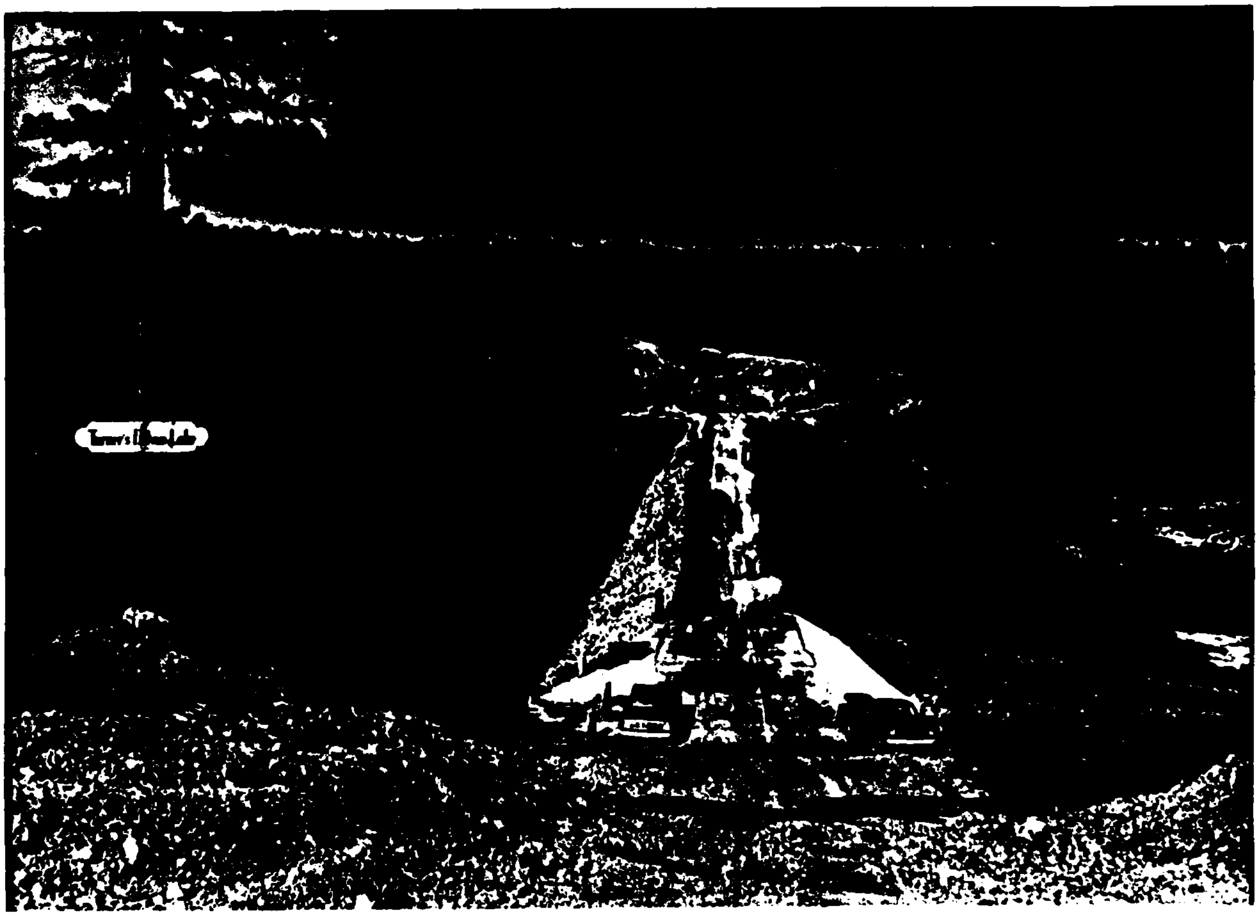
SUBMITTED BY: SIGNED — 28 SEP 1979
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 28 SEP 1979
Colonel, CE, District Engineer — Date



Overview of Lake Julia Dam and Lake

Overview of Lake of the Pines Dam and Lake



Overview of Turner's Dream Dam and Lake

Overview of Lake Janna Dam and Lake

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TURKEY CREEK DAMS

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Affected Downstream Features

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of the Turkey Creek Dams be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dams with respect to safety, based upon available data and visual inspection, in order to determine if the dams pose hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dams were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection" of Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dams and Appurtenances.

(1) General. Lake Julia Dam (Mo. 31101), Lake of the Pines Dam (Mo. 31109), Turner's Dream Lake Dam (Mo. 31108), and Lake Janna Dam (Mo. 31602) make up what are known as the Turkey Creek dams. The four Turkey Creek dams are presented in this Phase I inspection report because they act as a system both hydrologically and hydraulically.

(2) Dams. The dams are earth structures built in a narrow valley in the uplands which border the Mississippi Embayment. Topography adjacent to the valley is rolling to steep. Soils in the area are formed of red silty clays with fragments of dolomite and chert. Topography in the vicinity of the dams is shown on Plate 2A.

(3) Appurtenant Structures.

(a) Lake Julia (Mo. 31101). Two vertical slotted standpipes constructed of 14 inch diameter steel pipe junctioned at some point beneath the surface of the water and bottom of the lake with 122 feet of 14 inch diameter steel pipe is the primary means of discharge. The standpipes are capped and the means of entry is by numerous slots (3/4 in. X 2-1/2 in.) cut vertically in the periphery which extend for approximately 4 feet from the top of the pipes (see Photo 4B). An emergency spillway is cut in the right abutment. The emergency spillway is a trapezoidal section with a bottom width of approximately 25 feet and side slopes of approximately 1V on 12H. The low point on the top of dam is only 0.6 foot higher than the crest of the emergency spillway.

(b) Lake of the Pines (Mo. 31109). Two vertical slotted standpipes constructed of 14 inch diameter steel pipe junctioned at some point beneath the surface of the water and bottom of the lake with 190 feet of 14 inch diameter steel pipe is the primary means of discharge. The standpipe is capped and means of entry is by numerous slots (3/4 in. X 2-1/2 in.) cut vertically in the periphery which extends for approximately 4 feet from the top of the pipes (See Photo 4C). An emergency spillway is cut in the left abutment. The emergency spillway is a trapezoidal section with a bottom width of approximately 38 feet and side slopes 1V on 2H. Initially the emergency spillway is covered by a concrete roadway, however the critical constructed section, further down the emergency spillway, is cut into the hillside.

(c) Turner's Dream Lake (Mo. 31108). Two vertical slotted standpipes constructed of 14 inch diameter steel pipe junctioned at some point beneath the surface of the lake and bottom of the lake with 185 feet of 14 inch diameter steel pipe is the primary means of discharge. The standpipe is capped and means of entry is by numerous slots (3/4 in. X 2 1/2 in.) cut vertically in the periphery which extends for approximately 4 feet from the top of the pipes (see Photo 4D). Two emergency spillways are cut in the right and left abutment respectively. The emergency spillway in the right abutment is a trapezoidal section with a bottom width of approximately 14 feet and side slopes of 1V on 6.5H. The entire flow surface of this spillway is a concrete roadway. The emergency spillway in the left abutment is also a trapezoidal section with a bottom width of approximately 25 feet and side slopes of 1V on 5H.

(d) Lake Janna (Mo. 31602). Two separate drop inlet structures are the primary means of discharge for this dam. Each respective drop inlet consists of approximately 2 feet of 14 inch steel pipe junctioned with 40 feet of 14 inch steel pipe through the embankment (see Photo 4E). There is no emergency spillway for this structure.

(4) Pertinent physical data for each of the Turkey Creek Dams are given in paragraph 1.3 below.

b. Location. The dams are located in the west central portion of Wayne County, Missouri, as shown on the Shook, Missouri Quadrangle sheet in Section 3.5, Township 29 North, Range 7 East (See Plate 1A).

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1 c above. Based on these criteria, the dams and impoundments have the following size classifications.

Lake Julia (MO 31101)-- Small
Lake of the Pines (MO 31109) - Intermediate
Turner's Dream Lake (MO 31108) - Small
Lake Janna (MO 31602) - Small

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines and based on the fact that failure of one, all, or any combination of the upper dams could cause failure or overtopping of Turner's Dream Dam, all of the dams have been classified as high hazard dams.

e. Ownership. The Turkey Creek dams are owned by Mr. Bobby G. Turner of Route 2, Box 18, Lowndes, Missouri 63951.

f. Purpose of Dam. The dams form approximately 127 acres of recreational lakes for the Turkey Creek Resort.

g. Design and Construction History. Through conversation with the owner, it was determined that no design information was available on the Turkey Creek Dams. The dams were constructed by the present owner in the following years:

Lake Julia (Mo. 31101) - 1974
Lake of the Pines (Mo. 31109) - 1976
Turner's Dream Lake (Mo. 31108) - 1977
Lake Janna (Mo. 31602) - 1972

The dams were constructed of red silty clays containing chert and dolomite excavated from the lake area. The material was placed in lifts by 6-yd bottom scrapers and 9-yd paddle scrapers and then compacted by several passes of a sheeps-foot roller. Each lift was then graded before additional lifts were placed. Each dam reportedly has a clay cutoff trench to rock varying in depth from 48 feet to 52 feet.

h. Normal Operation Procedure. No operating records exist. Normal rainfall, runoff, transpiration and evaporation all combine to maintain relatively stable surface elevations behind each dam. The emergency spillways, except the left abutment spillway of Turner's Dream Lake Dam, have been used at each dam, but the maximum depth of flow in each spillway is unknown.

1.3 PERTINENT DATA

I. Lake Julia (Mo. 31101)

a. Drainage Area. - 335 acres (Topographic Quadrangle)

b. Discharge at Damsite.

(1) Discharge can take place through a set of vertical slotted standpipes junctioned with a single pipe which passes through the dam and an emergency spillway.

(2) Estimated experienced maximum flood at the damsite - Unknown

c. Elevation. (Feet above MSL)

(1) Observed Pool - 538.0
(2) Normal Pool - 536.1
(3) Spillway Crest - 540.5
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - Maximum - 543.9
Minimum - 541.1
(6) Maximum Pool (PMF) - 543.3
(7) Invert of Discharge Pipe - 508.7
(8) Streambed at Centerline of Dam - 508.0
(9) Maximum Tailwater - Unknown

d. Reservoir. Length of maximum pool - 1800± feet.

e. Storage. (Acre - feet)

(1) Observed Pool - 326
(2) Normal Pool - 284
(3) Spillway Crest - 385
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - Maximum - 481
Minimum - 400
(6) Maximum Pool (PMF) - 461

f. Reservoir Surface Area (Acres)

(1) Observed Pool - 23.0
(2) Normal Pool - 21.5
(3) Spillway Crest - 24.6
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - Maximum - 31.5
Minimum - 26.5
(6) Maximum Pool (PMF) - 30.4

g. Dam.

(1) Type - earth embankment
(2) Length - 650± feet
(3) Height - 34 feet maximum
(4) Top width - 17± feet
(5) Side Slopes
(a) Downstream - 1V on 2.5 H
(b) Upstream - 1V on 3.0 H
(6) Zoning - Unknown
(7) Impervious core - Unknown
(8) Cutoff - 50 foot deep trench with width unknown
(9) Grout curtain - Unknown

h. Diversion and Regulation Tunnel. None

i. Primary Discharge System.

(1) Type - Two vertical slotted 14 inch diameter steel pipes junctioned with a 14 inch diameter steel pipe (see para 1.2 a (2)(a) - Lake Julia).

(2) Length of 14 inch vertical pipes - Unknown

(3) Length of 14 inch horizontal pipe - 122 feet (horizontal distance)

(4) Top elevation of vertical pipe - 540.1 msl
(5) Invert of discharge pipe - 508.7 msl

j. Emergency Spillway.

(1) Type - Uncontrolled earthen with trapezoidal section
(2) Width of weir - 25 feet (bottom width)
(3) Length of weir - Not applicable
(4) Side Slopes - 1V on 12 H
(5) Crest Elevation - 540.5 msl

k. Regulating Outlet. None

II. Lake of the Pines (Mo. 31109)

a. Drainage Area. - 1189 acres (Topographic Quadrangle)

b. Discharge at Damsite.

(1) Discharge can take place through a set of vertical slotted standpipes junctioned with a single pipe which passes through the dam and an emergency spillway.

(2) Estimated experienced maximum flood at the damsite - Unknown

c. Elevation. (Feet above MSL)

(1) Observed Pool - 544.3
(2) Normal Pool - 542.7
(3) Spillway Crest - 544.4
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 549.0
(6) Maximum Pool (PMF) - 551.2
(7) Invert of Discharge Pipe - 508.6
(8) Streambed at Centerline of Dam - 510
(9) Maximum Tailwater - Unknown

d. Reservoir. Length of maximum pool - 3500± feet.

e. Storage. (Acre - feet)

(1) Observed Pool - 759
(2) Normal Pool - 665
(3) Spillway Crest - 761
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 1067
(6) Maximum Pool (PMF) - 1234

f. Reservoir Surface Area. (Acres)

(1) Observed Pool - 61.7
(2) Normal Pool - 56.7
(3) Spillway Crest - 62.0
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam 76.4
(6) Maximum Pool (PMF) - 83.3

g. Dam.

(1) Type - earth embankment
(2) Length = 875± feet
(3) Height - 44 feet maximum
(4) Top width - 21± feet
(5) Side slopes
    (a) Downstream - 1V on 2.6 H
    (b) Upstream - 1V on 2.8 H
(6) Zoning - Unknown
(7) Impervious core - Unknown
(8) Cutoff - 48 foot deep trench with width unknown
(9) Grout curtain - Unknown

h. Diversion and Regulation Tunnel. None

i. Primary Discharge System.

(1) Type - Two vertical slotted 14 inch diameter steel pipe junctioned with a 14 inch diameter steel pipe (see para 1.2 a (2)(b) - Lake of the Pines).
(2) Length of 14 inch vertical pipe - Unknown
(3) Length of 14 inch horizontal pipe - 190 feet horizontal distance
(4) Top elevation of vertical pipe - 546.7 (avg) msl
(5) Invert of discharge pipe - 508.6 msl

j. Emergency Spillway.

(1) Type - Uncontrolled earthen with trapezoidal section
(2) Width of weir - 38 feet (bottom width)
(3) Length of weir - Not applicable
(4) Side slopes - 1V on 2 H
(5) Crest Elevation - 544.4 msl.

k. Regulating Outlet. None

III. Turner's Dream Lake (Mo. 31108)

a. Drainage Area. - 241 acres
268 (includes drainage area for Lake Janna)

b. Discharge at Dam Site.

(1) Discharge can take place through a set of vertical slotted standpipes junctioned with a single pipe which passes through the dam and two emergency spillways.

(2) Estimated experienced maximum flood at damsite - Unknown

c. Elevation. (Feet above MSL)

(1) Observed Pool - 510.8
(2) Normal Pool - 509.8
(3) Spillway Crest - Right Abutment - 511.1
Left Abutment - 512.7
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - Maximum - 518.5
Minimum - 515.5
(6) Maximum Pool (PMF) - 519.3
(7) Invert of Discharge Pipe - 479.0
(8) Streambed at Centerline of Dam - 480
(9) Maximum Tailwater - Unknown

e. Storage. (Acre - feet)

(1) Observed Pool - 578
(2) Normal Pool - 531
(3) Spillway Crest - Right Abutment - 592
Left Abutment - 667
(4) Maximum Experineced Pool - Unknown
(5) Top of Dam - Maximum - 993
Minimum - 817
(6) Maximum Pool (PMF) - 1042

f. Reservoir Surface Area. (Acres)

(1) Observed Pool - 48.2
(2) Normal Pool - 46.3
(3) Spillway Crest - Right Abutment - 48.8
Left Abutment - 51.8
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - Maximum - 62.9
Minimum - 57.2
(6) Maximum Pool (PMF) - 64.4

g. Dam.

(1) Type - earth embankment
(2) Length - 600± feet
(3) Height - 38 feet maximum
(4) Top Width - 20± feet
(5) Side slopes
(a) Downstream - 1V on 3.5 H
(b) Upstream - 1V on 2.9 H
(6) Zoning - Unknown
(7) Impervious Core - Unknown
(8) Cutoff - 52 foot deep with the width unknown
(9) Grout curtain - Unknown

h. Diversion and Regulating Tunnel. None

i. Primary Discharge System.

(1) Type - Two vertical slotted 14 inch diameter steel pipes junctioned with a 14 inch diameter steel pipe (see para 1.2 a (2)(c) - Turner's Dream).
(2) Length of 14 inch vertical pipes - Unknown
(3) Length of 14 inch horizontal pipe - 185 feet (horizontal distance)
(4) Top elevation of vertical pipes - 513.8 (avg) msl.
(5) Invert of Discharge pipe - 479.0 msl.

j. Emergency Spillway.

(i) Right Abutment
(1) Type - Uncontrolled concrete-lined approximately in cross-section.
(2) Width of weir - 14 feet (bottom width)
(3) Length of weir - Not applicable
(4) Side slopes - 1V on 6.5 H
(5) Crest Elevation - 511.1 msl.

(ii) Left Abutment

(1) Type -Uncontrolled earthen trapezoidal in section
(2) Width of weir - 25 feet (bottom width)
(3) Length of weir - 250 from C_L of dam
(4) Side Slopes - 1V on 5 H
(5) Crest elevation - 512.7 msl

K. <u>Regulating Outlet</u>. None

IV. Lake Janna (Mo. 31602)

a. <u>Drainage Area.</u> - 26 acres (Topographic Quadrangle)

b. <u>Discharge at Damsite</u>.

(1) Discharge can take place through two separate drop inlet structures each junctioned with a horizontal pipe that passes through the dam.
(2) Estimated experienced maximum flood at the damsite - Unknown

c. <u>Elevation</u>. (Feet above MSL)

(1) Observed Pool - 535.6
(2) Normal Pool - 534.9
(3) Spillway Crest - None
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 537.5
(6) Maximum Pool (PMF) - 538.2
(7) Invert of Discharge Pipe - 532.7
(8) Streambed at Centerline of Dam - 510
(9) Maximum Tailwater - Unknown

d. <u>Reservoir</u>. Length of maximum pool - 900± feet

e. <u>Storage</u>. (Acre - feet)

(1) Observed Pool - 37
(2) Normal Pool - 35
(3) Spillway Crest - Not Applicable
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 42
(6) Maximum Pool (PMF) - 44

f. <u>Reservoir Surface Area</u>. (Acres)

(1) Observed Pool - 2.7
(2) Normal Pool - 2.6
(3) Spillway Crest - Not Applicable
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 2.8
(6) Maximum Pool (PMF) 2.9

g. Dam.

(1) Type - earthen embankment
(2) Length - 375± feet
(3) Height - 32 feet maximum
(4) Top Width - 20± feet
(5) Side Slopes
    (a) Downstream - 1V on 3.4 H
    (b) Upstream - 1V on 2.2 H
(6) Zoning - Unknown
(7) Impervious core - Unknown
(8) Cutoff - 48 foot deep with the width unknown
(9) Grout curtain - Unknown

h. Diversion and Regulating Tunnel. None

i. Primary Discharge System.

(1) Type - Two drop inlet structures constructed of 14 inch diameter steel pipe junctioned with 14 inch diameter steel pipe (see para 1.2 a (2)(d) - Lake Janna).
(2) Length of 14 inch vertical pipe - 2 feet
(3) Length of 14 inch horizontal pipe - 40 feet
(4) Top elevation of drop inlet - 534.9 msl
(5) Invert of discharge pipe - 532.7 msl

j. Emergency Spillway. None

k. Regulating Outlet. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data are known to exist.

2.2 CONSTRUCTION

The dams were constructed by the present owner in the following years:

Lake Julia - 1974
Lake of the Pines - 1976
Turner's Dream Lake - 1977
Lake Janna - 1972

The dams were constructed of red silty clays containing chert and dolomite excavated from the areas within the lakes. The material was placed in lifts by 6-yd bottom scrapers and 9-yd paddle scrapers and then compacted by several passes of a sheeps-foot roller. Each lift was then graded before additional lifts were placed. Each dam reportedly has a clay cutoff trench to rock varying in depth from 48 feet to 52 feet.

2.3 OPERATION

The emergency spillways, except the left abutment spillway at Turner's Dream Lake Dam, have been used at each dam, but the maximum depth of flow in each spillway is unknown.

2.4 EVALUATION

a. Availability. The only engineering data readily available is the personal recollection of the owner.

b. Adequacy. No hydraulic nor hydrologic design data was available to evaluate. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Turkey Creek Dams was performed on 16 May 1979. Personnel making the inspection were employees of the Memphis District, Corps of Engineers, and included a hydraulic engineer, geologist, and soils engineer. Specific observations are discussed below.

b. Lake Julia (Mo. 31101)

(1) Dam. No detrimental settlement, cracking, slides or animal burrows were observed in or near the earth embankment.

Typical existing cross-sections of the embankment are shown on Plate 3B. The crown width was 17 feet. Based on the existing cross-section, the upstream embankment has an average slope of 1V on 3.0 H (see Plate 3B and Photo 2B) and the downstream embankment has an average slope of 1V on 2.5 H (see Plate 3B and Photo 3B).

The growth of trees and bushes is almost non-existent on the dam embankments (see Photos 1B, 2B, and 3B). On the downstream embankment grass has been sown to prevent erosion. However, erosion gulleys have formed near the dam crest. The most serious of these gulleys have been repaired with riprap (see Photo 9B). The upstream slope is protected with riprap except near the right abutment. In this area, slight wavewash is present on the dam face (see Photo 6B).

Only one area of seepage was observed on the downstream embankment. A saturated spongy area was located approximately 43 feet downstream of Sta. 9+36. However, no significant flow was emerging from the area, and the seepage flow did not appear to be piping any material from the embankment. The inspection team was unable to check the downstream toe for seepage because it was submerged by the lake behind Turner's Dream Lake Dam (Mo. 31108).

Erosion gulleys exist on the upstream and downstream embankments of the left abutment (see Photos 7B and 8B). These gulleys are the result of surface runoff and do not pose a serious threat to the integrity of the dam.

(2) Appurtenent Structures. Two vertical slotted standpipes constructed of 14 inch diameter steel pipe extends junctioned at some point beneath the surface of the water and bottom of the lake with 122 feet of 14 inch diameter steel pipe is the primary means of discharge. The standpipe is capped and the means of entry is by numerous slots cut vertically in the periphery which extends for approximately 4 feet from the top of the pipes (see Photo 4B). The drop inlet appears to be in good condition. The outlet pipe was submerged by the lake behind Turner's Dream Lake Dam (Mo. 31108) and could not be inspected. An emergency spillway is cut in the right abutment. The emergency spillway is a concrete covered spillway of trapezoidal section with a bottom width of approximately 25 feet

and side slopes of approximately 1V on 12H. The low point on the top of dam is only 0.6 ft. higher than the crest of the emergency spillway. The emergency spillway and outfall channel appear to be in good condition.

(3) Reservoir Area. No wave wash, excessive erosion or slides were observed along the shore of the reservoir.

(4) Downstream Channel. No downstream channel exists because the lake behind Turner's Dream Lake Dam (Mo. 31108) extends to the landside toe of Lake Julia Dam (Mo. 31101).

c. Lake of the Pines (Mo. 31109).

(1) Dam. No detrimental settlement, cracking, slides or animal burrows were observed in or near the earth embankment.

Typical existing cross-sections of the embankment are shown on Plate 3C. The crown width was 20 feet. Based on the existing cross-section, the upstream embankment has an average slope of 1V on 2.8H (see Plate 3C and Photo 2C) and the downstream embankment has an average slope of 1V on 2.6H (see Plate 3C and Photo 3C).

The dam has no trees but a few small bushes growing on the downstream slope. Grass has been sown on the downstream slope and has prevented any major erosion (See Photo 1C). The upstream slope is protected by riprap up to within 3 feet of the dam crest (see Photo 2C). Only slight erosion and wavewash appear above the riprap on the upstream embankment.

Seepage emerges from the dam embankment in three locations. These locations are 97 feet downstream of Sta. 2+25, 87 feet downstream of Sta. 6+81 and 33 feet downstream of Sta. 8+70. Only the seep area downstream of Sta. 6+81 appears to be seeping more than 5 gpm. None of the seepage flows appeared to be piping material from the embankment or foundation.

Small erosion gulleys exist in each abutment on both the upstream and downstream embankments (see Photos 10C, 11C and 12C) and at the downstream embankment toe near the left abutment. These gulleys are the result of surface runoff and do not pose a serious threat to the integrity of the dam.

(2) Appurtenant Structures. Two vertical slotted standpipes constructed of 14 inch diameter steel pipe junctioned at some point beneath the surface of the water and bottom of the lake with 190 feet of 14 inch diameter steel pipe is the primary means of discharge. The standpipe is capped and means of entry is by numerous slots cut vertically in the periphery which extends for approximately 4 feet from the top of the pipes (see Photo 4C). The drop inlet appears to be in good condition. However, the discharge pipe was submerged by the lake behind Turner's Dream Lake Dam (Mo. 31108) and could not be inspected.

An emergency spillway is cut in the left abutment. The emergency spillway is a trapezoidal section with a bottom width of approximately 38 feet and side slopes 1V on 2H. Initially the emergency spillway is covered by a concrete roadway, however the critical constricted section further down the emergency spillway is cut into a hillside. Slight erosion exists in the spillway outfall channel for its entire length. Numerous natural springs also exist throughout the length of the outfall channel.

(3) Reservoir Area. No wave wash, excessive erosion or slides were observed along the shore or reservoir.

(4) Downstream Channel. No downstream channel exists because the lake behind Turner's Dream Lake Dam (Mo. 31108) extends to the landside toe of Lake of the Pines Dam (Mo. 31109).

d. Turner's Dream Lake (Mo. 31108).

(1) Dam. No detrimental settlement, cracking, slides or animal burrows were observed in or near the earth embankment. Typical existing cross-sections of the embankment are shown on Plate 3D. The crown width was 20 feet. Based on the existing cross-section, the upstream embankment has an average slope of 1V on 2.9 H (See Plate 3D), and the downstream embankment has an average slope of 1V on 3.5 H (see Plate 3D and Photo 3D).

This dam, being of recent construction, has no bushes or trees growing on the dam crest or embankments. Grass has been sown on the downstream slope, but it is not thick enough to prevent surface erosion (see Photo 3D). The upstream slope is protected by riprap up to the dam crest (see Photo 2D).

An area of light seepage flow is located 67 feet downstream of Sta. 2+00 near the right abutment. The area is soft and seeps less than 5 gpm. However, no material appeared to be piping from the embankment.

Numerous shallow erosion gulleys have formed on the downstream embankment (see Photo 9D). The erosion begins at Sta. 5+90 and extends to the left abutment. There is also an erosion gulley at the toe of the dam near the right abutment.

A low area with ponded water was observed approximately 100 feet from the left abutment near the embankment toe (see Photo 12D). The area was supporting a growth of small cattails. The water in this area was probably the result of surface runoff instead of seepage.

(2) Appurtenant Structures. Two vertical slotted standpipes constructed of 14 inch diameter steel pipe junctioned at some point beneath the surface of the lake and bottom of the lake with 185 feet of 14 inch diameter steel pipe is the primary means of discharge. The standpipe is capped and means of entry is by numerous slots cut vertically in the periphery which extends for approximately 4 feet from the top of the pipes (see Photo 4D). The drop inlet and discharge pipe appear to be in good condition. The outlet pipe discharges into an earth stilling basin located

approximately 138 feet downstream of the dam centerline (see Photo 6D). The stilling basin is approximately 40 feet in diameter.

Two emergency spillways are cut in the right and left abutments respectively. The emergency spillway in the right abutment is a trapezoidal section with a bottom width of approximately 14 feet and side slopes of 1V on 6.5 H. The entire flow surface of this spillway is a concrete roadway. Slight erosion exists throughout the length of the spillway outfall channel. The emergency spillway in the left abutment is also a trapezoidal section with a bottom width of approximately 25 feet and side slopes 1V on 5 H. Natural springs exist throughout the length of the left abutment spillway channel. Erosion gulleys in the spillway outfall channel appear to have been repaired.

(3) Reservoir Area. No wavewash, excessive erosion or slides were observed along the shore of the reservoir.

(4) Downstream Channel. The outlet channel consists of two streams which converge into one channel approximately 300 feet from the dam centerline. No trees or bushes exist in the outlet channel until approximately 400 feet from the dam centerline.

e. Lake Janna (Mo. 31602).

(1) Dam. No detrimental cracking, slides or animal burrows were observed in or near the earth embankment.

Typical existing cross-sections of the embankment are shown on Plate 2E. The crown width is 20 feet. Based on the existing cross-section, the upstream embankment has an average slope of 1V on 2.2 H (see Plate 3E and Photo 2E), and the downstream embankment has an average slope of 1V on 3.4 H (see Plate 3E and Photo 3E).

No trees or bushes are growing on the dam crest or embankments. A good stand of grass has been grown on the downstream embankment (see Photo 3E).

No seepage was reported in the abutments, downstream embankments or near the toe of the dam. However, the toe of the dam could not be inspected for seepage because it is submerged by the lake behind Turner's Dream Lake Dam (Mo. 31108).

Only slight erosion was observed on the dam embankments. The most serious erosion was a small gulley located in the left abutment (see Photo 7E). An erosion gulley also existed on the downstream embankment 50 feet from the left abutment (see Photo 8E).

At approximate Sta. 2+00 two depressions were observed on the downstream embankment. These depressions appeared to be the result of slight settlement of the dam embankment.

(2) Appurtenant Structures. Two separate drop inlet structures are the primary means of discharge for this structure (see Photo 4E). Each respective drop inlet consists of approximately 2 feet of 14 inch steel pipe junctioned with 40 feet of 14 inch horizontal pipe through the embankment. The drop inlets and outlet pipes appear to be in good condition. There is no emergency spillway for this structure. The outlet channel for the primary discharge was in good condition (see Photo 6E).

(3) Reservoir Area. No wave wash, excessive erosion, or slides were observed in the reservoir area.

(4) Downstream Channel. No downstream channel exists because the Lake behind Turner's Dream Lake Dam (Mo. 31108) extends to the land side toe of Lake Janna Dam (Mo. 31602).

3.2 EVALUATION

None of the conditions observed are significant enough to indicate a need for immediate remedial action or a serious potential of failure of any of the Turkey Creek Dams. Visually observed seepage, erosion on the dam embankments, and erosion in the spillway outfall channels are deficiencies which left uncontrolled or uncorrected could lead to the development of potential problems.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The primary discharge systems and emergency spillways for the Turkey Creek Dams are uncontrolled; therefore, no regulating procedures exist for these structures.

4.2 MAINTENANCE OF DAMS

The dam embankments and appurtenant structures appear well maintained.

4.3 MAINTENANCE OF OPERATING FACILITIES

Not applicable.

4.4 WARNING SYSTEM

The inspection team is not aware of any existing warning system for these dams.

4.5 EVALUATION

The maintenance of these dams appears adequate.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No hydraulic nor hydrology design data was available to evaluate.

b. Experience Data. The drainage area for the Turkey Creek Dams was developed using the USGS Gipsy, Missouri; Lowndes, Missouri; McGee, Missouri; and Shook, Missouri Quadrangles. The spillway and dam layouts are from surveys made during the inspection.

c. Visual Observations.

(1) Lake Julia (Mo. 31101).

(a) The vertical drop inlets and emergency spillway are in good condition.

(b) The vertical shafts are located approximately in the center of the dam, while the spillway is located in the right abutment. Releases from either structure will not endanger the integrity of the dam.

(2) Lake of the Pines (Mo. 31109).

(a) The vertical drop inlets and emergency spillway are in good condition.

(b) The vertical shafts are located approximately in the center of the dam, while the spillway is located in the left abutment. Releases from either structure will not endanger the integrity of the dam.

(3) Turner's Dream Lake (Mo. 31108).

(a) The vertical drop inlets and emergency spillways are in good condition.

(b) The vertical shafts are located approximately in the center of the dam, while spillways are located in both the left and right abutment. Releases from the principal outlet or either spillway will not endanger the integrity of the dam.

(4) Lake Janna (Mo. 31602).

(a) The vertical drop inlets are in good condition.

(b) The vertical shafts are the only means of discharge and are located near the right abutment.

d. <u>Overtopping Potential</u>. For the size classification of small to intermediate and a high hazard potential, the respective spillway/spillways of each dam must pass the Probable Maximum Flood (PMF). The Probable Maximum Flood is defined as the flood discharge that may be discharged from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

(1) Lake Julia Dam (Mo 31101). The spillway will safely pass 9 percent of the Probable Maximum Flood (PMF) at a discharge of 46 cfs without overtopping. The PMF will overtop the embankment for a period of 18 hours at a maximum depth of 2.2 feet with a peak discharge of 3800 cfs. The 1/2 PMF will overtop the embankment for a period of 12 hours at a maximum depth of 1.6 feet with a peak discharge of 1800 cfs. The 10-year frequency flood will also overtop the embankment. Due to the fact that failure of Lake Julia Dam (Mo 31101) will cause failure or overtopping of Turner's Dream Lake Dam (Mo 31108), this dam is required by the guidelines to pass the PMF. Because the spillway will not pass the 1/2 PMF without overtopping and will not pass the 10-year frequency flood without overtopping, Lake Julia Dam (Mo 31101) is classified as "unsafe emergency".

(2) Lake of the Pines Dam (Mo 31109). The spillway will safety pass 20 percent of the PMF at a discharge of 1100 cfs without overtopping. The PMF will overtop the embankment for a period of 7 hrs at a maximum depth of 2.2 feet with a peak discharge of 9300 cfs. The 1/2 PMF will overtop the embankment for a period of 4.5 hours at a maximum depth of 1.3 feet with a peak discharge of 4500 cfs. The 100-year frequency flood will not overtop the embankment. Due to the fact that failure of Lake of the Pines Dam (Mo 31109) will cause failure or overtopping of Turner's Dream Lake Dam (Mo 31108), this dam is required by the guidelines to pass the PMF. Because the spillway will not pass the 1/2 PMF without overtopping, the dam is classified as "unsafe non-emergency".

(3) Turner's Dream Lake Dam (Mo 31108). The spillway will safely pass 20 percent of the PMF at a discharge of 1500 cfs without overtopping. The PMF will overtop the embankment for a period of 8 hours at a maximum depth of 3.8 feet with a peak discharge of 14000 cfs. The 1/2 PMF will overtop the embankment for a period of 5 hours at a maximum depth of 2.2 feet with a peak discharge of 6600 cfs. The 100-year frequency flood will not overtop the embankment. Due to the high hazard potential to life and property downstream of the dam, this dam is required by the guidelines to pass the PMF. Because the spillway will not pass the 1/2 PMF without overtopping, and because Lake Julia Dam (Mo 31101) would fail or be overtopped by the 10-year frequency flood which in turn would cause overtopping or failure of Turner's Dream Lake Dam (Mo 31108), Turner's Dream Lake Dam (Mo 31108) is classified as "unsafe emergency".

(4) **Lake Janna Dam (Mo 31602).** Lake Janna Dam has no emergency spillway. The routing procedure was started at the top of the drop inlet structures and all references to flow are made with respect to this initial condition. The outlet structures will safely pass 25 percent of the PMF at a discharge of 40 cfs without overtopping. The PMF will overtop the embankment for a period of 5.5 hours at a maximum depth of 0.7 feet with a peak discharge of 440 cfs without overtopping. The 1/2 PMF will overtop the embankment for a period of 4 hours at a maximum depth of 0.5 feet with a peak discharge of 220 cfs. The 100-year frequency flood will marginally pass the structure without overtopping based on the above mentioned initial conditions. Due to the high hazard potential to life and property downstream of the Turkey Creek Dams, this dam is required to pass the PMF. Because the structure will not pass the 1/2 PMF without overtopping, the dam is classified as "unsafe non-emergency".

The data utilized in the preparation of the estimates was obtained from various Federal reports, data from field inspection and survey of each respective dam and output from COE program, HEC-1, Dam Safety Version.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of the Turkey Creek Dams and their appurtenant structures are discussed and evaluated in SECTIONS 3 and 5.

b. Design and Construction Data. The design and construction data were limited to that information discussed in SECTION 2.

c. Operation Records. There have been no operations which have affected the structrual stability of the Turkey Creek Dams.

d. Post Construction Changes. No post construction changes exist which will affect the structural stability of the dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 ASSESSMENT OF DAMS

a. Safety. A few items were noted during the visual inspection of the Turkey Creek Dams which should be corrected or controlled. These items are detailed in paragraph 7.2 c. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

The emergency spillway for Lake Julia Dam (Mo 31101) will pass only 9 percent of the PMF before the dam embankment is overtopped. Because the spillway will not pass 1/2 of the PMF without overtopping and will not pass the 10-year frequency flood without overtopping, Lake Julia Dam (Mo 31101) is classified as "unsafe emergency".

The emergency spillway for Lake of the Pines Dam (Mo 31109), will pass only 20 percent of the PMF before the dam embankment is overtopped. Because the spillway will not pass 1/2 of the PMF without overtopping but will pass the 10-year frequency flood, Lake of Pines Dam (Mo 31109) is classified as "unsafe non-emergency". The spillway will pass the 100-year flood without overtopping, which is a flood that has a 1 percent chance of being exceeded in any given year.

The emergency spillway for Turner's Dream Lake Dam (Mo 31108) will pass only 20 percent of the PMF before the dam embankment is overtopped. The spillway will pass the 100-year flood without overtopping. However, Turner's Dream Lake Dam (Mo 31108) is classified as "unsafe emergency" due to the 10-year frequency flood overtopping and probable failure of Lake Julia Dam (Mo 31101) which in turn could cause overtopping and failure of Turner's Dream Lake Dam (Mo 31108).

The discharge structure for Lake Janna Dam (MO 31602) will pass only 25 percent of the PMF before the dam embankment is overtopped. The discharge structure for Lake Janna Dam (MO 31602) will marginly pass the 100-year frequency flood. Because the discharge structure will not pass 1/2 of the PMF but will pass the 10-year frequency flood, Lake Janna Dam (Mo 31602) is classified as "unsafe non-emergency".

b. Adequacy of Information. Due to the lack of engineering design and construction data, the conclusions in this report were based on performance history and external visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. However, seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

c. Urgency. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2 a should be pursued on a high-priority basis.

d. Necessity for Phase II. Based on the results of the Phase I inspection, no Phase II inspection is recommended.

e. Seismic Stability. The dams are located in Seismic Zone 2. However, they are located very near the boundary between Seismic Zones 2 and 3. Since these dams are located in Seismic Zone 2 and the proximity of Seismic Zone 3, it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the dams.

7.2 REMEDIAL MEASURES

a. Alternatives. Spillway sizes at each dam and/or the height of each dam should be increased to pass the Probably Maximum Flood without overtopping the dams.

b. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. The seepage conditions described for each dam in Section 3 should be taken into account in performing the seepage and stability analyses.

c. O & M Maintenance and Procedures. The following O & M maintenance procedures are recommended:

(1) Lake Julia Dam (Mo 31101)

(a) Riprap should be placed on the upstream slope near the right abutment where the riprap blanket is non-existent. This will prevent further deterioration of the dam section from wave wash.

(b) The saturated, spongy area on the downstream embankment at Sta. 9+36 should be monitored for seepage. If seepage develops, then this condition should be rectified.

(c) The erosion gulleys on the upstream and downstream embankment near the left abutment should be repaired.

(d) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

(2) Lake of the Pines Dam (Mo 31109)

(a) The downstream embankment should be monitored closely for seepage and erosion. If seepage quantities and/or erosion observed during monitoring indicate increases or signs of material being piped from the embankment, immediate action should be taken to rectify these conditions.

(b) The erosion gulleys in each abutment on both the upstream and downstream embankments should be repaired.

(c) A detailed inspection of the dam should be made periodically by an engineer experienced in design and construction of dams.

(3) Turner's Dream Lake Dam (Mo 31108)

(a) Establish and maintain a grass cover on the downstream embankment slope.

(b) Repair the downstream embankment near the dam crest where numerous erosion gulleys have formed.

(c) The downstream embankment at approximate Sta 2+00 should be monitored closely for seepage and erosion. If seepage quantities and/or erosion observed during monitoring indicate increases or signs of material being piped from the embankment, immediate action should be taken to rectify these conditions.

(d) A detailed inspection of the dam should be made periodically by an engineer experienced in design and construction of dams.

(4) Lake Janna Dam (Mo 31602)

(a) Monitor the small depressions in the downstream embankment at Sta. 2+00. If the depressions increase in size, action should be taken to rectify the condition.

(b) A detailed inspection of the dam should be made periodically by an engineer experienced in design and construction of dams.

APPENDIX A

HYDROLOGY AND HYDRAULICS

APPENDIX A
HYDROLOGY AND HYDRAULICS

Narrative. The methods and sources of data were primarily those suggested by the Hydraulics Branch, St. Louis District Corps of Engineers. Specific references and method will be discussed below. Each particular section will be discussed as a whole except where specific differences necessitate discussing each dam uniquely. A field inspection and survey was made to determine the topographic and physical features of the dam and outlet structures. HEC-1, Dam Safety Version was used in conjunction with appropriate input parameters to compute inflow hydrographs, determine storage and route the flow through each respective structure. The hydraulic analysis consisted of analyzing Lake Julia and Lake of the Pines on an individual basis with respect to the overtopping potential and then analyzing Turner's Dream in tandem using the outflow hydrographs from Lake Julia and Lake of the Pines plus the sub-area inflow hydrograph of Turner's Dream. A 48-hour duration rainfall was used in this analysis. Also the drainage area and any consequent stoɒage due to the location of Lake Janna was considered as part of Turner's Dream during this analysis. Lake Janna was so small that it was analyzed using a 24-hour duration rainfall by itself to develop the overtopping potential.

a. Rainfall. The PMF was developed using Hydrometeorological Report No. 33. The "Hop Brook" reduction factor was not used to adjust the rainfall for this study. The distribution of rainfall was developed using the criteria as described by EM 1110-2-1411 (Standard Project Storm).

(1) Lake Julia, Lake of the Pines, and Turner's Dream 48- hour duration

PMF Rainfall	27.0 inches
PMF Percentages	6 hr - 102
	12 hr - 120
	24 hr - 130
	48 hr - 140

(2) Lake Janna - 24 hour duration

PMF Rainfall	27.0 inches
PMF Percentages	6 hr - 102
	12 hr - 120
	24 hr - 130

b. Unit Hydrograph Coefficients. The unit hydrograph for each respective drainage basin was developed using the Snyder Method as outlined in HEC-1, Dam Safety Version. Two methods of determining time of concentration were used, namely the Snyder Method and Kirpich Method. The two equations are described below and then the respective input parameters are listed separately.

Snyder Method: $t_p = C_t\ (L\ L_{CG})^{0.3}$; L and L_{CG} in miles

Kirpich: $t_c = .00013 \left(\frac{L \text{ ft}}{\sqrt{\text{Slope, ft/ft}}} \right)^{.77}$

Where L = length of the main stream channel from the outlet to the divide; when used in Kirpich Equation, the unit is feet.

L_{CG} = length along the main channel to a point opposite the watershed centroid

C_t = Coefficient used in Snyder Method

t_p = time to peak, hours

t_c = time of concentration, hours

(1) Lake Julia

L = 4620 ft = 0.88 mi.

L_{CG} = 2860 ft = 0.54 mi.

Stream slope = 124 ft/mi = .023 ft/ft

C_t = .5

t_p = 0.40 hr. (Snyder)

t_c = 0.37 hr. (Kirpich)

A time to peak of 30 minutes was chosen to describe the unit hydrograph for the drainage basin for several reasons. Namely .5 hours is not too much different than the approximate 25 minutes indicated by the formula; .5 hours was necessary to achieve the minimum number of ordinates to describe the unit hydrograph that would be compatible with using a 48-hour PMF and 10-minute duration rainfall.

Using a t_p of 0.5 hours, the Snyder Method gave a t_c=0.63 hours as developed by HEC-1, Dam Safety Version.

(2) Lake of the Pines

$L = 11000$ ft $= 2.08$ mi.

$L_{CG} = 6740$ ft $= 1.28$ mi.

Stream slope = 63 ft/mi = .012 ft/ft

$C_t = .7$

$t_p = 0.94$ hr. (Snyder)

$t_c = 0.92$ hr. (Kirpich)

A t_p of 60 minutes was chosen to develop the unit hydrograph characteristics since this value agrees very well with the predicted values of Snyder's time to peak and Kirpich time of concentration. The t_c was 1.16 hours as developed by HEC-1, Dam Safety Version.

(3) Turner's Dream

$L = 5100$ ft $= 0.97$ mi.

$L_{CG} = 2960$ ft $= 0.56$ mi.

Stream Slope = 107 ft/mile = .020 ft/ft

$C_t = .5$

$t_p = 0.42$ hr(Snyder)

$t_c = 0.42$ hr(Kirpich)

A t_p of 0.5 hours was chosen primarily for the same reason discussed in the Lake Julia section. The t_c was 0.65 hours as developed by HEC-1, Dam Safety Version.

(4) Lake Janna

$L = 1500$ ft $= 0.28$ mi.

$L_{CG} = 800$ ft $= 0.15$ mi.

stream slope = 179 ft/mi = .033 ft/ft

$C_t = .5$

$t_p = 0.19$ hr Snyder)

$t_c = 0.13$ hr(Kirpich)

These values were so low that a representative value of tp = 15 minutes was chosen and 24-hour PMF with a 5 minute duration rainfall was

selected to model the inflow hydrograph to Lake Janna.

The general soils map of Wayne County indicates that these dams lie in an area where the soil is of the Clarksville Association which is gently sloping to moderately steep soils that have loamy subsoil with fragipan. This places the area in a Soil Group B. The primary soil cover consists of woods in a fair hydrologic condition which gives a value of CN of 78 for antecedent moisture condition III. Hence a value for C_p of about .65 was chosen for all but Turner's Dream to be used in the Snyder Method for unit hydrograph development. For Turner's Dream a value of C_p of .7 was chosen since about 20 percent of the drainage area is lake surface. HEC-1 actually balances the C_p value to achieve one inch of volume under the hydrograph but the values are still very nearly the same. The remaining parameters for the Snyder unit hydrograph are listed below:

(i) Lake Julia
C_p = .651
Drainage Area = 0.523 sq. mi.

(ii) Lake of the Pines
C_p = .653
Drainage Area = 1.858 sq. mi.

(iii) Turner's Dream
C_p = .699
Drainage Area = .418 sq. mi.

(iv) Lake Janna
C_p = .652
Drainage Area = .041 sq. mi.

The unit hydrograph ordinates are found in the computer printout for each respective analysis.

c. <u>Loss Rates</u>. A loss rate of .5 inches initially and .05 in/hr was chosen for each analysis based upon engineering experience.

d. <u>Base Flow and Antecedent Flood Conditions</u>. A base flow of 1 cfs was selected and the routing was starting at the respective low points in the emergency spillway for each structure except Lake Janna where the routing was started at the top of the drop inlet. Listed below are the appropriate starting elevations.

Dam	Elevation, msl
Lake Julia	540.5
Lake of the Pines	544.4
Turner's Dream	511.1
Lake Janna	534.9

e. Hydrograph Routing. HEC-1, Dam Safety Version uses the single routing step of the "Modified Puls" method. Routing through the emergency spillway and over the embankment was accomplished using the non-level dam top option of the HEC-1, Dam Safety Version coupled with a critical energy consideration of the flow. The routing through the standpipes or drop inlet was determined on an individual basis. A particular problem was encountered concerning how to evaluate the flow through the vertical slots for all dams except Lake Janna. The orifice equation was utilized to estimate the flow per slot based on some average head and then accumulated over a given depth of flow. These values were then compared to pipe full conditions and it was found that pipe full conditions govern over the depths considered. Only those parameters necessary to calculate flow for pipe full conditions will be listed. Also it was decided to use a head loss coefficient of 1.0 to account for entrance losses. In addition only the horizontal pipe distance could be ascertained during the field survey. With these restraints denoted, listed below are the pertinent parameters used to rate the flow through the primary discharge structures.

Common Assumptions

head losses: $h_{ent} = \frac{V^2}{2g}$

$h_{bend} = \frac{V^2}{2g}$

$h_{exit} = \frac{V^2}{2g}$

h_f = friction loss (Manning's Equation)

(1) Lake Julia

D = 14 inch - steel pipe
L = 122 feet
n = .012
$Q = .4207 A_{14} \sqrt{2g} \; H^{1/2}$
Invert Elevation from which to calculate H,
height of head = 509.2 msl.

(2) Lake of the Pines

D = 14 inch - steel pipe
L = 190 feet
n = .012
$Q = .3746 A_{14} \sqrt{2g} \; H^{1/2}$
Invert Elevation from which to calculate H,
height of head = 509.2 msl.

(3) Turner's Dream

D = 14 inch - steel pipe
L = 185 feet
n = .012
$Q = .3775\ A_{14}\sqrt{2g}\ \ H^{1/2}$
Invert Elevation from which to calculate H,
height of head = 479.7 msl.

(4) Lake Janna. Since the routing for Lake Janna started at the high point of the drop inlet, two conditions of flow existed namely; (1) weir flow and (2) pipe-full flow.

No. of pipes = 2
D = 14 inch - steel pipe
L = vertical = 2.2 feet
length = 40 feet

head losses:

$$h_{ent} = .5\ \frac{V2}{2g}$$

$$h_{bend} = \frac{V2}{2g}$$

$$h_{exit} = \frac{V2}{2g}$$

(1) Weir Flow/pipe: $Q = 3.1\ P_{14}\ H^{3/2}$
(2) Pipe Full/pipe: $Q = .5449^{14} A_{14}\ \sqrt{2g}\ \ H^{3/2}$

H_1, measured from top of drop inlet at elevation = 534.9 msl.
H_2, measured from centerline of outlet end of pipe = 533.2 msl.

The rating curve was input into the computer model on Y4 and Y5 cards and can be found as input for the Lake Janna analysis.

f. Storage. The storage was calculated using the option without HEC-1, Dam Safety Version with input consisting of elevation and respective surface areas which were McGee, Missouri; Shook, Missouri; and Lowdes, Missouri Quadrangle.

Computer Input

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************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
  LAST MODIFICATION   26 FEB 79
************************************

A                              NON-FEDERAL DAM INSPECTION
A                                       DAM #31108
A                                      TURNERS DREAM
B      300       0      10      -0      -0      -0      -0      -0      -0      -0
B1       5
J        1       9       1
J1      .1     .15      .2     .25      .3     .35      .4      .5      1.
K        0       1                                       1
M                     PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION
M        1       1    .523            .523      1.
P             27.0     102     120     130     140
T                                                       .5     .05
W       .5    .651
X        1       1       2
K        1       2                                       1
K1                             ROUTED FLOWS THROUGH LAKE JULIA DAM
Y                                1       1
Y1       1                                           -540.5
$A       0   9,092  24,548  60,006
$E     504     520     540     560
$$   540.5                           509.3   .4207   1.069      .5
$D   541.1
$L       0      25      34     355     475     550     794     825     917
$V   540.5   540.6   541.1   541.4   542.5   542.5   543.9     545     550
K                3                                       1
M                     PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION
M        1       1   1.858           1.858      1.
P             27.0     102     120     130     140
T                                                       .5     .05
W     1.01    .653
X        1       1       2
K        1       4                                       1
K1                        ROUTED FLOWS THROUGH LAKE OF THE PINES
Y                                1       1
Y1       1                                           -544.4
$A       0       0   7,577  48,187 110,920
$E     509     510     520     540     560
$$   544.4                           509.2   .3746   1.069      .5
$D   549.0
$L       0      24      38      56     581     838     918     968     981    1020
$V   544.4   544.7   545.4   549.0   549.0   550.2   551.0   551.0   551.5   552.5
K                5                                       1
M                     PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION
M        1       1    .418            .418      1.
P             27.0     102     120     130     140
T                                                       .5     .05
W       .5    .699
X        1       1       2
K        4       6                                       1
K1COMB OUTF HYDRO FROM LAKE JULIA, LAKE OF THE PINES AND INFLOW TO TURNERS DREAM
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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE: 27 AUG 79
     TIME: 10.45.03
```

NON-FEDERAL DAM INSPECTION (LAKE JULIA)

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                                    JOB SPECIFICATION
   NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
  300        0       10       -0       -0       -0       -0       -0       -0       -0
                           JOPER      NWT    LROPT    TRACE
                               5       -0       -0       -0

                           MULTI-PLAN ANALYSES TO BE PERFORMED
                              NPLAN= 1 NRTIO= 9 LRTIO= 1
      RTIOS=    .10     .15     .20     .25     .30     .35     .40     .50    1.00


  **********          **********          **********          **********          **********

                                SUB-AREA RUNOFF COMPUTATION

                     PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION

                   ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                       1        0       -0       -0       -0       -0        1       -0       -0

                                      HYDROGRAPH DATA
          IHYDG     IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO    ISNOW    ISAME    LOCAL
              1        1      .52      -0.      .52     1.00      -0.      -0       -0       -0

                                       PRECIP DATA
                 SPFE      PMS       R6      R12      R24      R48      R72      R96
                  -0.    27.00   102.00   120.00   130.00   140.00      -0.      -0.

                                        LOSS DATA
     LROPT    STRKR    DLTKR    RTIOL    ERAIN    STRKS    RTIOK    STRTL    CNSTL    ALSMX    RTIMP
        -0      -0.      -0.     1.00      -0.      -0.     1.00      .50      .05      -0.      -0.

                                   UNIT HYDROGRAPH DATA
                             TP=   .50     CP= .65     NTA= -0

                                      RECESSION DATA
                         STRTQ=    1.00    QRCSN=    1.00    RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.80 AND R= 2.22 INTERVALS

              UNIT HYDROGRAPH 14 END-OF-PERIOD ORDINATES, LAG=    .50 HOURS, CP= .66  VOL= 1.00
       71.       245.       405.       428.       372.       203.       128.        81.        51.        32.
       20.        13.         8.         5.

       0                                  END-OF-PERI    FLOW
  MO.DA   HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q       MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q
```

SUMMARY OF DAM SAFETY ANALYSIS (LAKE JULIA)

....		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	540.50	540.50	541.10
	STORAGE	385.	385.	400.
	OUTFLOW	20.	20.	57.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	540.49	0.	385.	20.	0.	0.	0.
.06	540.49	0.	385.	20.	0.	0.	0.
.07	540.49	0.	385.	20.	0.	0.	0.
.08	540.71	0.	390.	25.	0.	42.83	0.
.09	540.99	0.	397.	46.	0.	42.67	0.

SUMMARY OF DAM SAFETY ANALYSIS (LAKE JULIA)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	540.50	540.50	541.10
STORAGE	385.	385.	400.
OUTFLOW	20.	20.	57.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	541.21	.11	403.	72.	1.83	42.50	0.
.15	541.74	.64	417.	321.	4.50	40.67	0.
.20	542.03	.93	425.	641.	5.67	40.33	0.
.25	542.17	1.07	429.	856.	6.83	40.33	0.
.30	542.29	1.19	432.	1044.	7.83	40.33	0.
.35	542.39	1.29	435.	1228.	8.50	40.33	0.
.40	542.48	1.38	438.	1412.	9.33	40.33	0.
.50	542.65	1.55	442.	1782.	11.83	40.17	0.
1.00	543.31	2.21	461.	3756.	18.33	40.17	0.

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SUB-AREA RUNOFF COMPUTATION (LAKE OF THE PINES)

PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	-0	-0	-0	-0	-0	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.86	-0.	1.86	1.00	-0.	-0	-0	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
-0.	27.00	102.00	120.00	130.00	140.00	-0.	-0.

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.	-0.	1.00	-0.	-0.	1.00	.50	.05	-0.	-0.

UNIT HYDROGRAPH DATA

TP= 1.01 CP= .65 NTA= -0

RECESSION DATA

STRTQ= 1.00 QRCSN= 1.00 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.96 AND R= 5.04 INTERVALS

UNIT HYDROGRAPH 31 END-OF-PERIOD ORDINATES, LAG= 1.00 HOURS, CP= .65 VOL= 1.00

50.	182.	359.	547.	700.	781.	777.	684.	561.	460.
377.	309.	253.	207.	170.	139.	114.	94.	77.	63.
52.	42.	35.	28.	23.	19.	16.	13.	11.	9.
7.									

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.00	0.	.00	1.	1.02	1.10	151	.03	.02	.01	74.
1.01	.20	2	.00	0.	.00	1.	1.02	1.20	152	.03	.02	.01	88.
1.01	.30	3	.00	0.	.00	1.	1.02	1.30	153	.03	.02	.01	101.
1.01	.40	4	.00	0.	.00	1.	1.02	1.40	154	.03	.02	.01	111.
1.01	.50	5	.00	0.	.00	1.	1.02	1.50	155	.03	.02	.01	119.
1.01	1.00	6	.00	0.	.00	1.	1.02	2.00	156	.03	.02	.01	125.
1.01	1.10	7	.00	0.	.00	1.	1.02	2.10	157	.03	.02	.01	131.
1.01	1.20	8	.00	0.	.00	1.	1.02	2.20	158	.03	.02	.01	135.
1.01	1.30	9	.00	0.	.00	1.	1.02	2.30	159	.03	.02	.01	139.
1.01	1.40	10	.00	0.	.00	1.	1.02	2.40	160	.03	.02	.01	142.
1.01	1.50	11	.00	0.	.00	0.	1.02	2.50	161	.03	.02	.01	145.
1.01	2.00	12	.00	0.	.00	0.	1.02	3.00	162	.03	.02	.01	147.
1.01	2.10	13	.00	0.	.00	0.	1.02	3.10	163	.03	.02	.01	148.
1.01	2.20	14	.00	0.	.00	0.	1.02	3.20	164	.03	.02	.01	150.
1.01	2.30	15	.00	0.	.00	0.	1.02	3.30	165	.03	.02	.01	151.
1.01	2.40	16	.00	0.	.00	0.	1.02	3.40	166	.03	.02	.01	152.
1.01	2.50	17	.00	0.	.00	0.	1.02	3.50	167	.03	.02	.01	152.
1 [illegible]	3.00	18	.00	0.	.00	0.	1.02	4.00	168	.03	.02	.01	153.
1	3.10	19	.00	0.	.00	0.	[illegible]	4.10	169	.03	.02	.01	154.
1.01	3.20	20	.00	0.	.00	0.	[illegible]	4.20	170	.03	.02	.01	154.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.00	0.	1.02	4.30	171	.03	.02	.01	154.
									[illegible]	[illegible]	[illegible]	[illegible]	155.

SUMMARY OF DAM SAFETY ANALYSIS (LAKE OF THE PINES)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	544.40	544.40	549.00
STORAGE	761.	761.	1067.
OUTFLOW	19.	19.	1197.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	546.97	0.	925.	432.	0.	42.50	0.
.15	547.95	0.	991.	756.	0.	42.17	0.
.20	548.76	0.	1049.	1088.	0.	42.00	0.
.25	549.31	.31	1090.	1646.	2.17	41.50	0.
.30	549.60	.60	1112.	2316.	2.67	41.17	0.
.35	549.82	.82	1128.	2949.	3.33	41.00	0.
.40	549.99	.99	1141.	3525.	3.67	40.83	0.
.50	550.25	1.25	1161.	4541.	4.50	40.83	0.
1.00	551.18	2.18	1234.	9305.	6.83	40.67	0.

1201.	1217.	1226.	1234.	1233.	1227.	1218.	1210.	1202.	[illegible]
1188.	1182.	1176.	1170.	1164.	1157.	1149.	1141.	1132.	1122.
1113.	1104.	1096.	1088.	1081.	1074.	1067.	1059.	1052.	1043.
1035.	1027.	1020.	1012.	1005.	998.	992.	985.	980.	974.
969.	964.	959.	955.	951.	947.	943.	940.	937.	934.
931.	928.	924.	921.	918.	914.	910.	906.	902.	899.

STAGE

544.4	544.4	544.4	544.4	544.4	544.4	544.4	544.4	544.4	544.4
544.4	544.3	544.3	544.3	544.3	544.3	544.3	544.3	544.3	544.3
544.3	544.3	544.3	544.3	544.3	544.3	544.3	544.3	544.3	544.3
544.3	544.3	544.3	544.3	544.2	544.2	544.2	544.2	544.2	544.2
544.2	544.2	544.2	544.2	544.2	544.2	544.2	544.2	544.2	544.2
544.2	544.2	544.2	544.2	544.2	544.2	544.2	544.1	544.1	544.1
544.1	544.1	544.1	544.1	544.1	544.1	544.1	544.1	544.1	544.1
544.1	544.1	544.1	544.1	544.1	544.1	544.1	544.1	544.1	544.1
544.1	544.1	544.2	544.2	544.2	544.3	544.3	544.4	544.4	544.5
544.5	544.6	544.6	544.7	544.8	544.9	545.0	545.1	545.2	545.4
545.5	545.6	545.7	545.8	545.8	545.9	545.9	546.0	546.0	546.0
546.1	546.1	546.1	546.1	546.1	546.0	546.0	546.0	546.0	546.0
545.9	545.9	545.9	545.8	545.8	545.8	545.8	545.7	545.7	545.7
545.6	545.6	545.6	545.6	545.6	545.5	545.5	545.5	545.5	545.4
545.4	545.4	545.4	545.4	545.3	545.3	545.3	545.3	545.3	545.3
545.3	545.3	545.3	545.3	545.3	545.3	545.3	545.3	545.4	545.4
545.4	545.4	545.4	545.4	545.4	545.4	545.5	545.5	545.5	545.5
545.5	545.5	545.5	545.5	545.5	545.6	545.6	545.6	545.6	545.6
545.6	545.6	545.6	545.7	545.7	545.8	545.8	545.9	546.0	546.1
546.2	546.3	546.4	546.5	546.6	546.7	546.8	546.9	547.0	547.1
547.2	547.3	547.3	547.4	547.5	547.5	547.6	547.6	547.7	547.7
547.8	547.8	547.9	547.9	547.9	548.0	548.0	548.0	548.1	548.1
548.2	548.4	548.6	548.8	549.0	549.2	549.4	549.6	549.7	549.8
549.9	549.9	550.0	550.0	550.1	550.1	550.2	550.2	550.4	550.5
550.8	551.0	551.1	551.2	551.2	551.1	551.0	550.9	550.8	550.7
550.6	550.5	550.4	550.4	550.3	550.2	550.1	550.0	549.9	549.7
549.6	549.5	549.4	549.3	549.2	549.1	549.0	548.9	548.8	548.7
548.6	548.5	548.3	548.2	548.1	548.0	547.9	547.9	547.8	547.7
547.6	547.5	547.5	547.4	547.4	547.3	547.2	547.2	547.2	547.1
547.1	547.0	547.0	546.9	546.9	546.8	546.8	546.7	546.6	546.6

PEAK OUTFLOW IS 9305. AT TIME 40.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9305.	5010.	1638.	818.	245252.
CMS	263.	142.	46.	23.	6945.
INCHES		25.08	32.80	34.11	34.11
MM		637.10	833.09	866.34	866.34
AC-FT		2484.	3248.	3378.	3378.
THOUS CU M		3064.	4007.	4167.	4167.

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION (TURNER'S DREAM)

PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

HYDROGRAPH DATA (TURNER'S DREAM)

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.42	-0.	.42	1.00	-0.	-0	-0	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
-0.	27.00	102.00	120.00	130.00	140.00	-0.	-0.

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.	-0.	1.00	-0.	-0.	1.00	.50	.05	-0.	-0.

UNIT HYDROGRAPH DATA
TP= .50 CP= .70 NTA= -0

RECESSION DATA
STRTQ= 1.00 QRCSN= 1.00 RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.92 AND R= 1.87 INTERVALS

UNIT HYDROGRAPH 12 END-OF-PERIOD ORDINATES, LAG= .50 HOURS, CP= .70 VOL= 1.00

62.	212.	347.	366.	266.	154.	89.	51.	30.	17.
10.	6.								

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.00	0.	.00	1.	1.02	1.10	151	.03	.02	.01	32.
1.01	.20	2	.00	0.	.00	1.	1.02	1.20	152	.03	.02	.01	34.
1.01	.30	3	.00	0.	.00	1.	1.02	1.30	153	.03	.02	.01	34.
1.01	.40	4	.00	0.	.00	1.	1.02	1.40	154	.03	.02	.01	35.
1.01	.50	5	.00	0.	.00	1.	1.02	1.50	155	.03	.02	.01	35.
1.01	1.00	6	.00	0.	.00	1.	1.02	2.00	156	.03	.02	.01	35.
1.01	1.10	7	.00	0.	.00	1.	1.02	2.10	157	.03	.02	.01	35.
1.01	1.20	8	.00	0.	.00	1.	1.02	2.20	158	.03	.02	.01	35.
1.01	1.30	9	.00	0.	.00	1.	1.02	2.30	159	.03	.02	.01	35.
1.01	1.40	10	.00	0.	.00	1.	1.02	2.40	160	.03	.02	.01	35.
1.01	1.50	11	.00	0.	.00	0.	1.02	2.50	161	.03	.02	.01	35.
1.01	2.00	12	.00	0.	.00	0.	1.02	3.00	162	.03	.02	.01	35.
1.01	2.10	13	.00	0.	.00	0.	1.02	3.10	163	.03	.02	.01	35.
1.01	2.20	14	.00	0.	.00	0.	1.02	3.20	164	.03	.02	.01	35.
1.01	2.30	15	.00	0.	.00	0.	1.02	3.30	165	.03	.02	.01	35.
1.01	2.40	16	.00	0.	.00	0.	1.02	3.40	166	.03	.02	.01	35.
1.01	2.50	17	.00	0.	.00	0.	1.02	3.50	167	.03	.02	.01	35.
1.01	3.00	18	.00	0.	.00	0.	1.02	4.00	168	.03	.02	.01	35.
1.01	3.10	19	.00	0.	.00	0.	1.02	4.10	169	.03	.02	.01	35.
1.01	3.20	20	.00	0.	.00	0.	1.02	4.20	170	.03	.02	.01	35.
1.01	3.30	21	.00	0.	.00	0.	1.02	4.30	171	.03	.02	.01	35.
1.01	3.40	22	.00	0.	.00	0.	1.02	4.40	172	.03	.02	.01	35.
1.01	3.50	23	.00	0.	.00	0.	1.02	4.50	173	.03	.02	.01	35.
1.01	4.00	24	.00	0.	.00	0.	1.02	5.00	174	.03	.02	.01	35.
1.01	4.10	25	.00	0.	.00	0.	1.02	5.10	175	.03	.02	.01	35.
1.01	4.20	26	.00	0.	.00	0.	1.02	5.20	176	.03	.02	.01	35.
1.01	4.30	27	.00	0.	.00	0.	1.02	5.30	177	.03	.02	.01	35.
1.01	4.40	28	.00	0.	.00	0.	1.02	5.40	178	.03	.02	.01	35.
1.01	4.50	29	.00	0.	.00	0.	1.02	5.50	179	.03	.02	.01	35.
1.01	5.00	30	.00	0.	.00	0.	1.02	6.00	180	.03	.02	.01	35.
1.01	5.10	31	.00	0.	.00	0.	1.02	6.10	181	.14	.13	.01	41.
1.01	5.20	32	.00	0.	.00	0.	1.02	6.20	182	.14	.13	.01	64.
1.01	5.30	33	.00	0.	.00	0.	1.02	6.30	183	.14	.13	.01	100.
1.01	5.40	34	.00	0.	.00	0.	1.02	6.40	184	.14	.13	.01	139.
1.	5.50	35	.00	0.	.00	0.	[illegible]	6.50	185	.14	.13	.01	167.
1.	6.00	36	.00	0.	.00	0.	1.02	7.00	186	.14	.13	.01	183.
1.01	6.10	37	.01	0.	.01	0.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SUMMARY OF DAM SAFETY ANALYSIS (TURNER'S DREAM)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	511.10	511.10	515.50
STORAGE	592.	592.	817.
OUTFLOW	18.	18.	1586.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	513.70	0.	723.	454.	0.	43.50	0.
.15	514.71	0.	774.	974.	0.	42.50	0.
.20	515.36	0.	810.	1484.	0.	42.17	0.
.25	515.99	.49	845.	2185.	2.83	41.67	0.
.30	516.49	.99	873.	3082.	3.50	41.33	0.
.35	516.89	1.39	896.	3989.	3.63	41.00	0.
.40	517.21	1.71	916.	4884.	4.33	40.83	0.
.50	517.72	2.22	946.	6557.	5.17	40.67	0.
1.00	519.26	3.76	1042.	14020.	7.63	40.50	0.

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************
```

(LAKE JANNA)

```
  1        A                      NON-FEDERAL DAM INSPECTION
  2        A                        NO NUMBER ASSIGNED
  3        A                            LAKE JANNA
  4        B    300       0       5      -0      -0      -0      -0      -0      -0      -0
  5        1      5
  6        J      1       9       1
  7        1     .1     .15      .2     .25      .3     .35      .4      .5      1.
  8        K      0       1                                       1
  9        1                PROBABLE MAXIMUM PRECIPITATION-24 HR DURATION
 10        M      1       1    .041            .041      1.
 11        P           27.0     102     120     130
 12        T                                                     .5     .05
 13        W    .25    .652
 14        X      1       1       2
 15        K      1       2                                       1
 16        K1                          ROUTED FLOWS THROUGH LAKE JANNA
 17        Y                              1       1
 18        Y1     1                                          -534.9      -1
 19        Y4 534.9   535.4   535.9   536.4   536.9   537.4   537.9   538.4   538.9   539.9
 20        Y5     0    8.04   15.36   16.72   17.98   19.16   20.27   21.32   22.32   24.20
 21        SA     0   1.515   3.031   4.243
 22        SE   510     520     540     560
 23        SS 534.9
 24        SD 537.5
 25        SL     0     150     310     381     414
 26        SV 537.5   537.5     538     539     540
 27        K     99
```

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
 LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE: 21 AUG 79
     TIME: 08.21.56
```

NON-FEDERAL DAM INSPECTION
NO NUMBER ASSIGNED
LAKE JANNA

(LAKE JANNA)

```
                              JOB SPECIFICATION
      NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
     300       0       5      -0      -0      -0      -0      -0      -0      -0
                           JOPER     NWT   LROPT   TRACE
                               5      -0      -0      -0

                       MULTI-PLAN ANALYSES TO BE PERFORMED
                         NPLAN= 1 NRTIO= 9 LRTIO= 1
      RTIOS=    .10    .15    .20    .25    .30    .35    .40    .50   1.00


 **********        **********        **********        **********        **********

                           SUB-AREA RUNOFF COMPUTATION

                  PROBABLE MAXIMUM PRECIPITATION-24 HR DURATION

                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                       1       0      -0      -0      -0      -0       1      -0      -0

                                   HYDROGRAPH DATA
      IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
          1       1     .04     -0.     .04    1.00     -0.      -0      -0      -0

                                     PRECIP DATA
            SPFE     PMS      R6     R12     R24     R48     R72     R96
             -0.   27.00  102.00  120.00  130.00     -0.     -0.     -0.

                                      LOSS DATA
   LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
      -0     -0.     -0.    1.00     -0.     -0.    1.00     .50     .05     -0.     -0.

                                 UNIT HYDROGRAPH DATA
                             TP=   .25     CP= .65     NTA= -0

                                    RECESSION DATA
                         STRTQ=    1.00    QRCSN=    1.00    RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.80 AND R= 2.21 INTERVALS

         UNIT HYDROGRAPH 14 END-OF-PERIOD ORDINATES, LAG=    .25 HOURS, CP= .66   VOL= 1.00
       11.       39.       64.       67.       50.       32.       20.       13.        8.        5.
        3.        2.        1.        1.

                                   END-OF-PERIOD FLOW
    MO.DA   HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q      MO   HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q

     1.01     .05       1    .02      0    .02
```

SUMMARY OF DAM SAFETY ANALYSIS (LAKE JANNA)

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	534.90	534.90	537.50
STORAGE	35.	35.	42.
OUTFLOW	0.	0.	19.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	535.86	0.	38.	15.	0.	16.33	0.
.15	536.42	0.	39.	17.	0.	16.58	0.
.20	537.07	0.	41.	18.	0.	17.25	0.
.25	537.59	.09	43.	33.	2.17	16.42	0.
.30	537.74	.24	43.	84.	2.50	16.08	0.
.35	537.84	.34	43.	137.	2.75	15.92	0.
.40	537.89	.39	43.	169.	2.92	15.83	0.
.50	537.96	.46	44.	217.	3.67	15.83	0.
1.00	538.20	.70	44.	443.	5.58	15.83	0.

APPENDIX B

GEOLOGY OF DAMSITE

APPENDIX B
GEOLOGY OF DAMSITE

General Geology. The following geologic information was obtained from a search of the very limited available literature, one field inspection of the site and the Shook quarry about 8 miles southwest of Turkey Creek, and core borings taken recently by the Memphis District Corps of Engineers in connection with a subsurface investigation of Wappapello Dam (15 miles south of Turkey Creek).

Field investigations conducted at Turkey Creek revealed rock on two of the hills surrounding the lake. This material was determined to be float. Other investigations as mentioned earlier indicate the dam to be founded on 60 to 140 feet of residuum material underlain by crystalline dolomite of the Gasconade formation of the Ordovician System.

Subsurface investigations at Wappapello Dam indicate 60 to 140 feet of residuum material underlain by crystalline rock. The residuum is composed of red clay with sand and rock fragments of limestone, dolomite and chert. A light tan to gray, medium to coarsely crystalline dolomite with numerous vuggy zones and inclusions of yellow to tan chalky chert were found beneath the residuum. The formation is believed to be the Roubidoux and contains zones of dolomitic limestone and dolomitic sandstone. The top 30 to 35 feet of this formation contained zones that were highly fractured with numerous solution cavities. The Roubidoux was found to vary in thickness from 60 to 80 feet with the base of the formation being fairly confident rock with minor fractures and vugs. At the base of the Roubidoux black shale partings underlain by a lense of siltstone were found. The underlying rock was very similar to the Roubidoux but believed to be the Gasconade formation. It consisted of tannish gray and gray mottled medium crystalline dolomite containing numerous irregular styblites and pink calcite inclusions. Several lenticular zones of sandstone, dolomitic sandstone and cherty dolomite were found in the top 100 feet of this formation. Vuggy Zones existed that were partly filled with tan stained calcite. Predominately this formation is sound rock with only a few fractured zones.

Field investigations at the Shook quarry indicate about 100 feet of residuum material. It had been stripped off during the quarry operation and was impossible to determine the exact thickness. The residuum was underlain with dolomite believed to be the Gasconade formation.

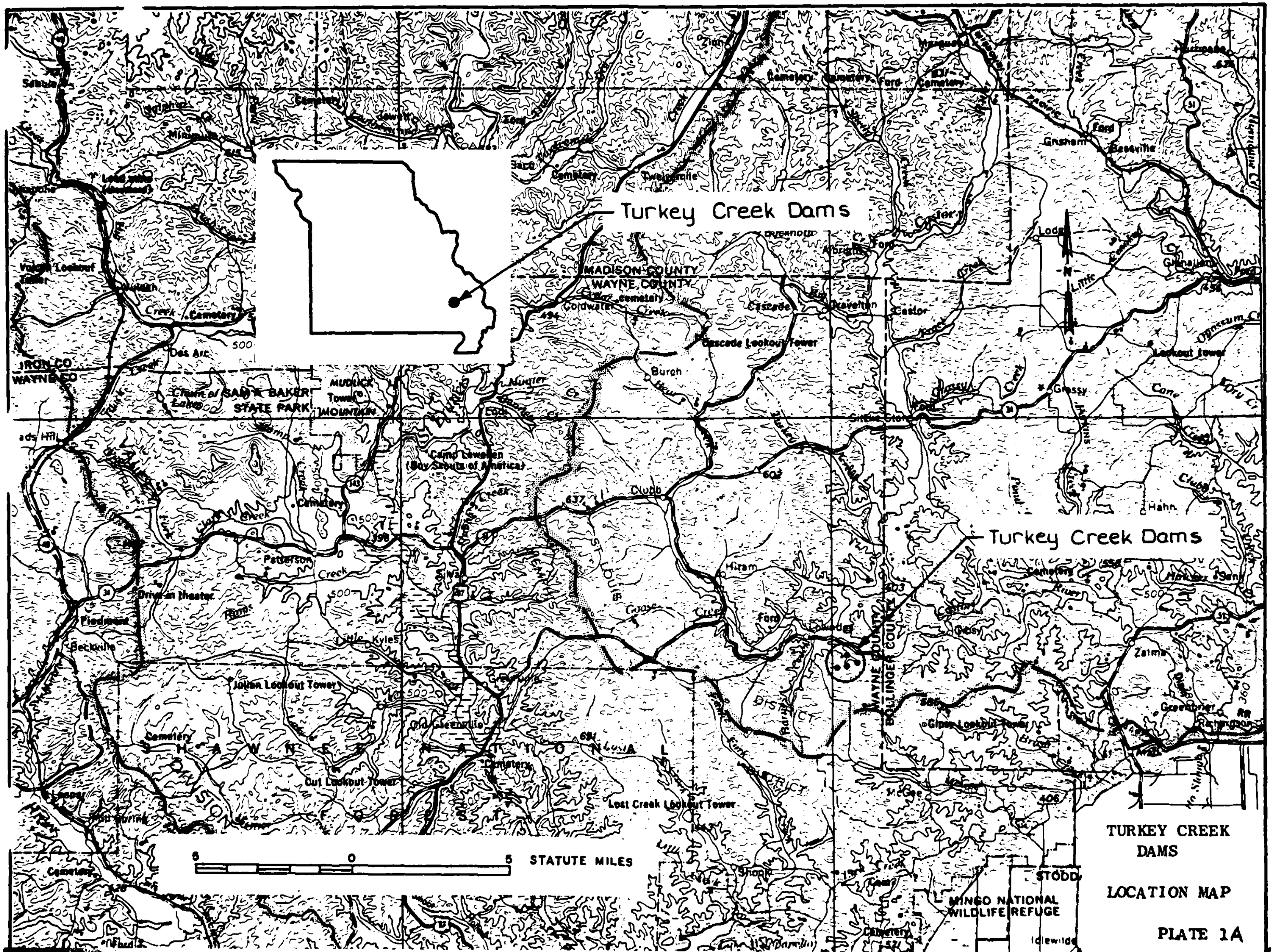
Regional structure of the area is controlled somewhat by the Mississippi Embayment, a southerly plunging syncline whose axis is basically outlined by the course of the Mississippi River. The regional dip of the beds is about 1 to 2 degrees toward the Mississippi Embayment.

Two major joint systems are present in this area. One system runs northwest to southeast and a second northeast of southwest with vertical fractures. A minor joint system exists in the North-South and East-West directions. The topography and stream patterns of the area are greatly

influenced by these joints. Solutions zones were found to exist along joints and bedding planes. Caves and sink holes of various sizes are numerous in some areas of the Roubidoux and the Gasconade which are a direct result of solution activity.

Site Description. Turkey Creek dams are situated in an area of rolling hills with the maximum relief being about 100 feet. Prior to construction of the dams, valley drainage served as a minor tributary to Bear Creek. Field investigations revealed an outcrop on a recent road cut west of dam 31101 and on a hill north west of dam 31109 at about elevation 575.0 msl. The rock consisted of interbedded sandstone, siltstone and cherty dolomite. The sandstone had a very weak, highly erodable red zone that graded into a more resistant granular sandstone. The siltstone layers were about 6 inches in thickness, friable and highly erodable. The cherty dolomite was highly resistant to weathering but fractured and broke into fragments and blocks as the sandstone and siltstone weathered. No other outcrops were found. It was reported by local residents that water wells had been drilled to a depth of 210 feet without encountering confident rock. Therefore the outcrops are believed to be float. Similar rock characteristics exist at Wappapello Dam on the north abutment but after exploration it was determined to be float.

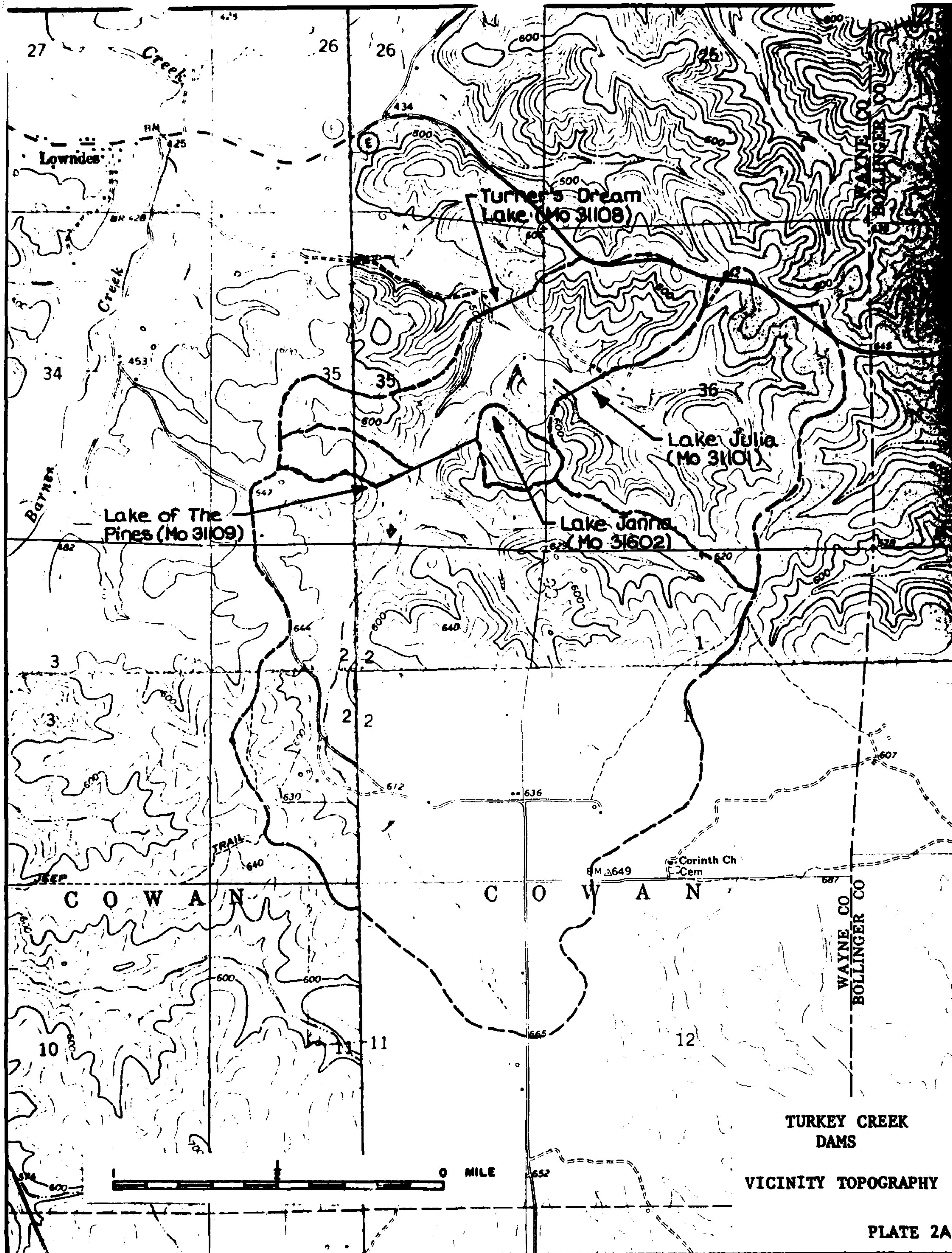
All the Turkey Creek Dams were constructed of predominately the same material. The embankment, abutment and foundation material are the same, consisting of residuum. The residuum is composed of red clay with sand and rock fragments. The residuum thickness at the dam site may range from 60 to 200 feet. Considering other investigations and the regional structure the float material may be of the Roubidoux formation. The residuum is probably underlain by dolomite or dolomitic limestone of the Gasconade formation, of which the top 30 feet probably exists as a weathered surface with solution cavities and fractured zones. Numerous areas of seepage were located on the dams and this problem will be addressed in another section of this report. No other hazardous features such as soft seams,expansive clays or other geologic irregularities were noted. However, the lake is located within the Seismic Risk Zone 2 but borders very close to the Seismic Risk Zone 3.



TURKEY CREEK DAMS

LOCATION MAP

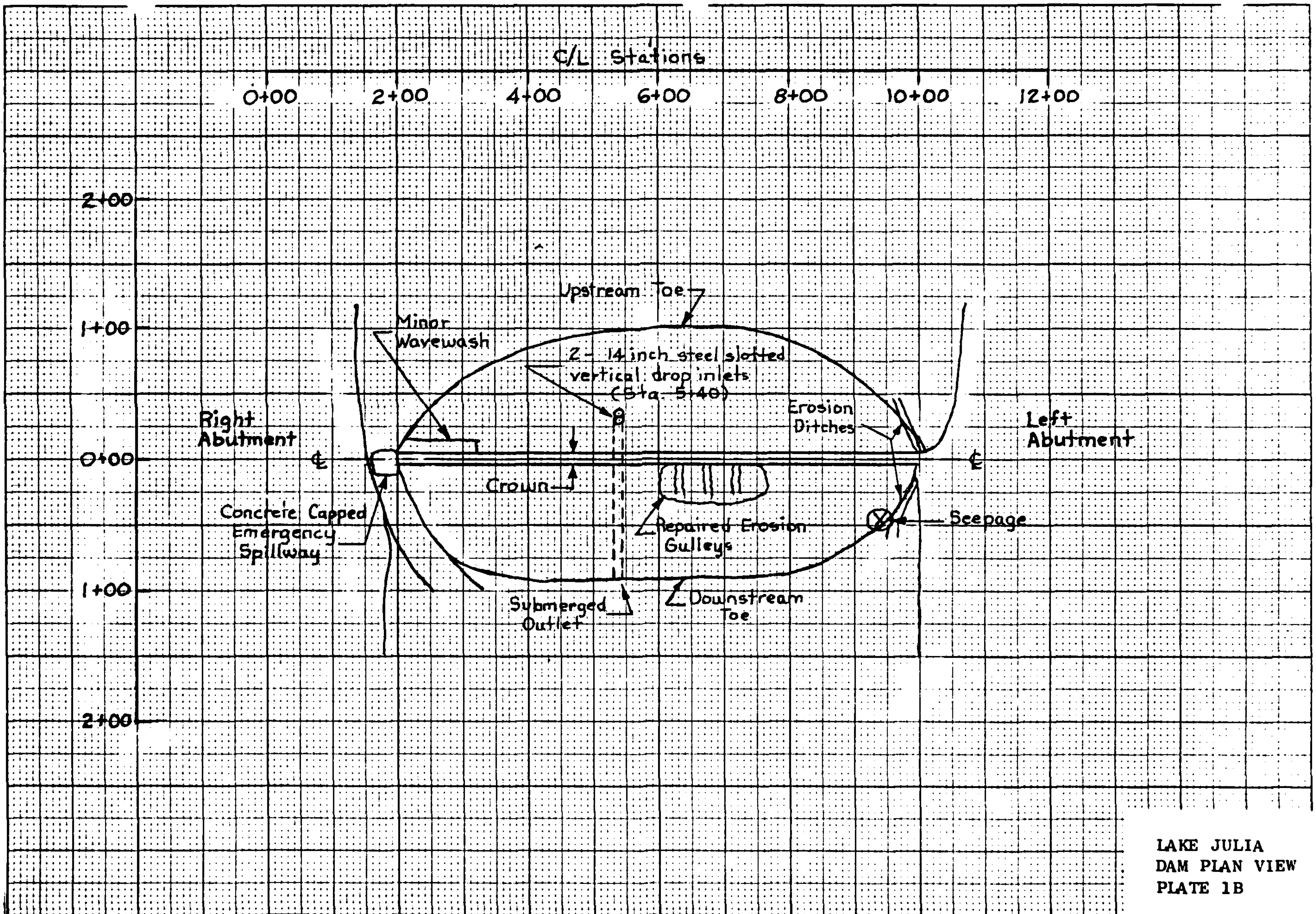
PLATE 1A



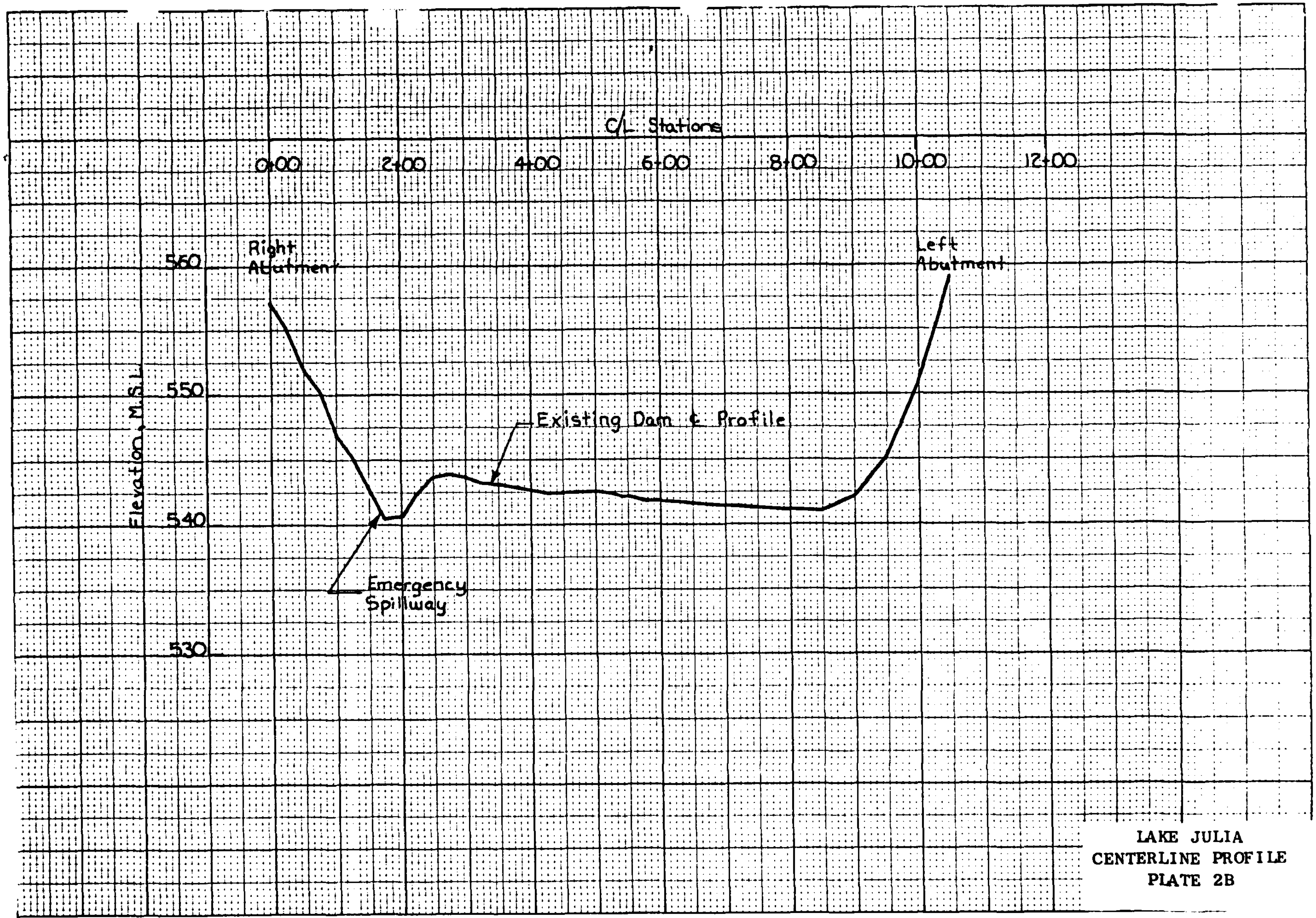
TURKEY CREEK
DAMS

VICINITY TOPOGRAPHY

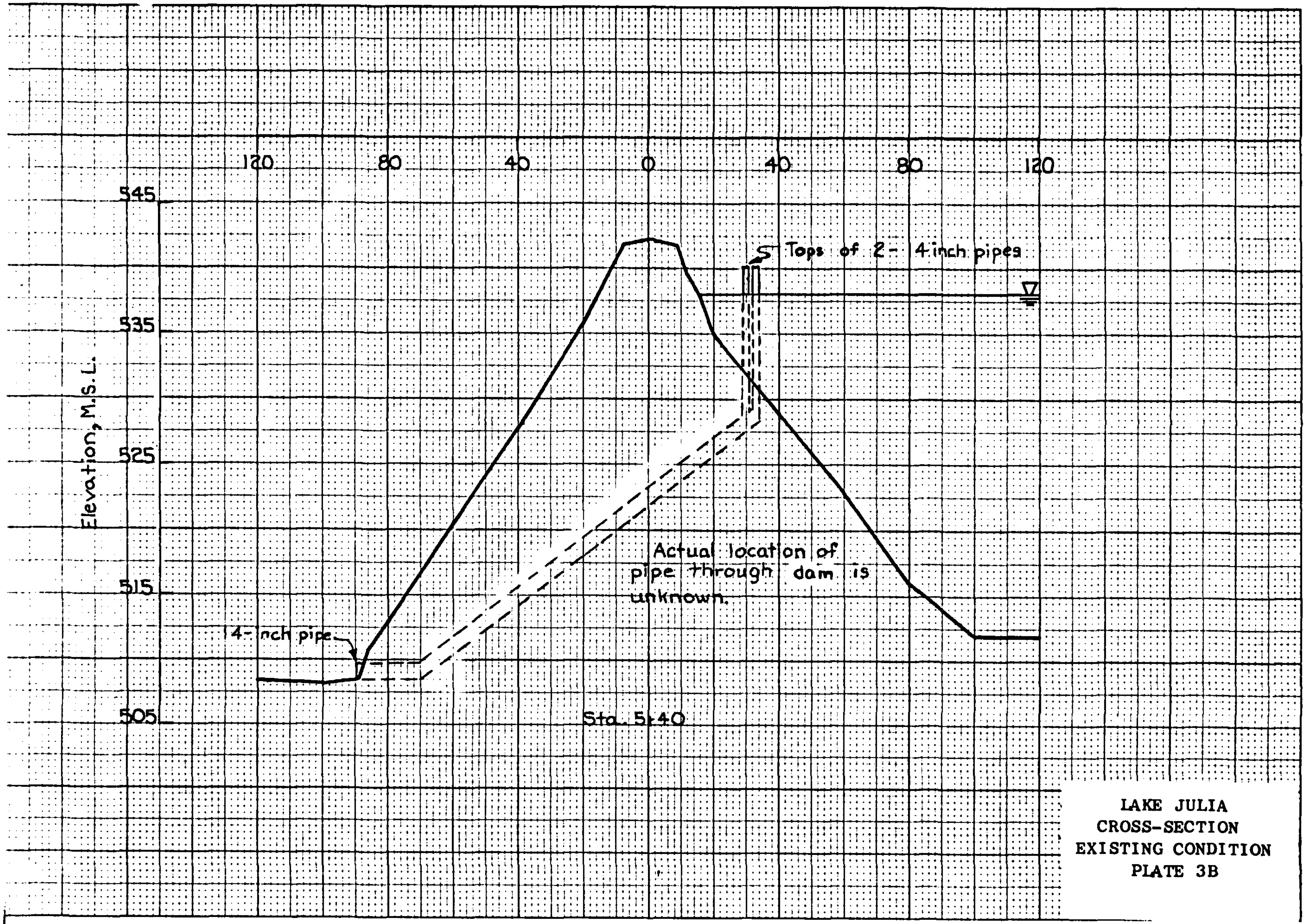
PLATE 2A



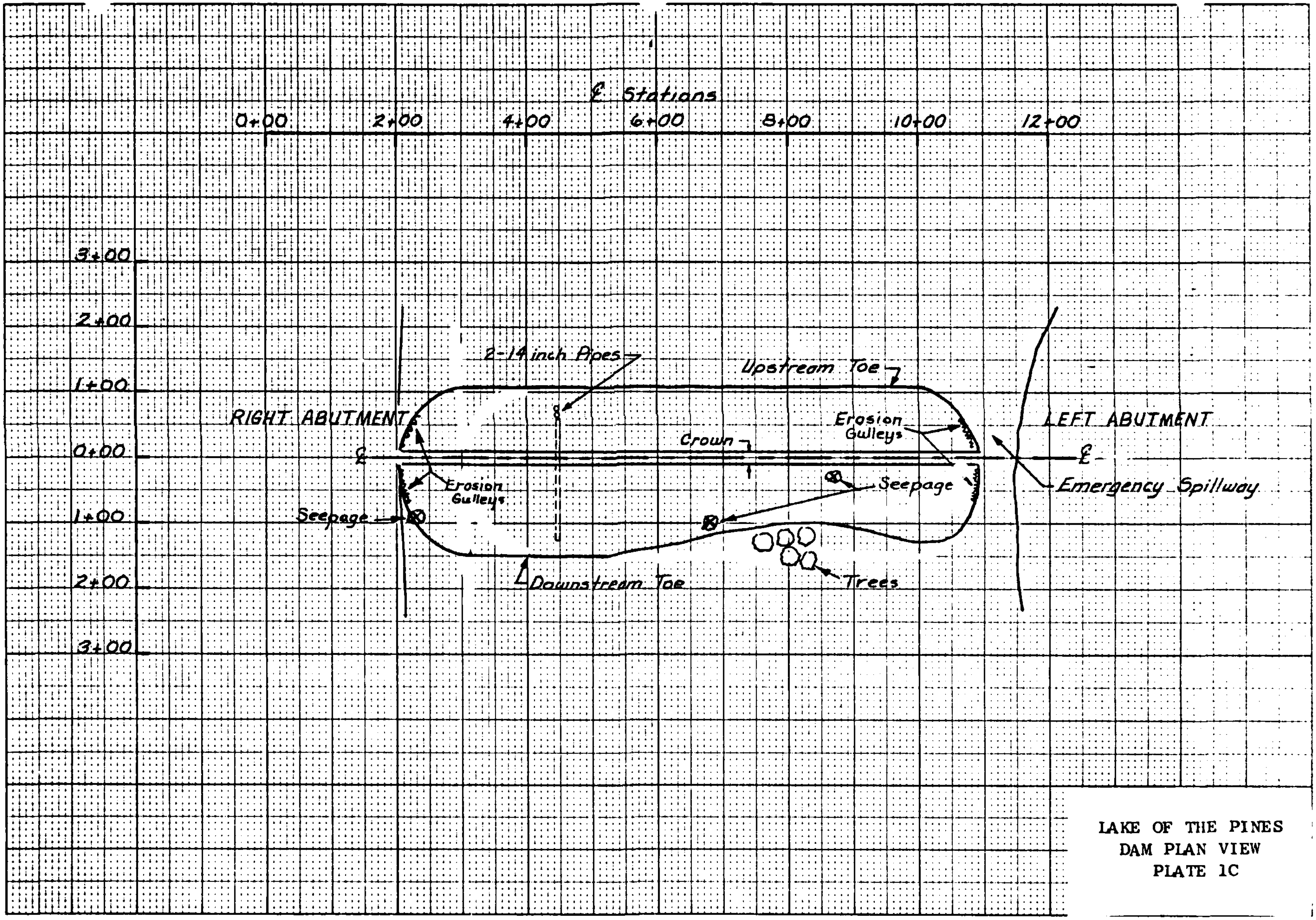
LAKE JULIA
DAM PLAN VIEW
PLATE 1B



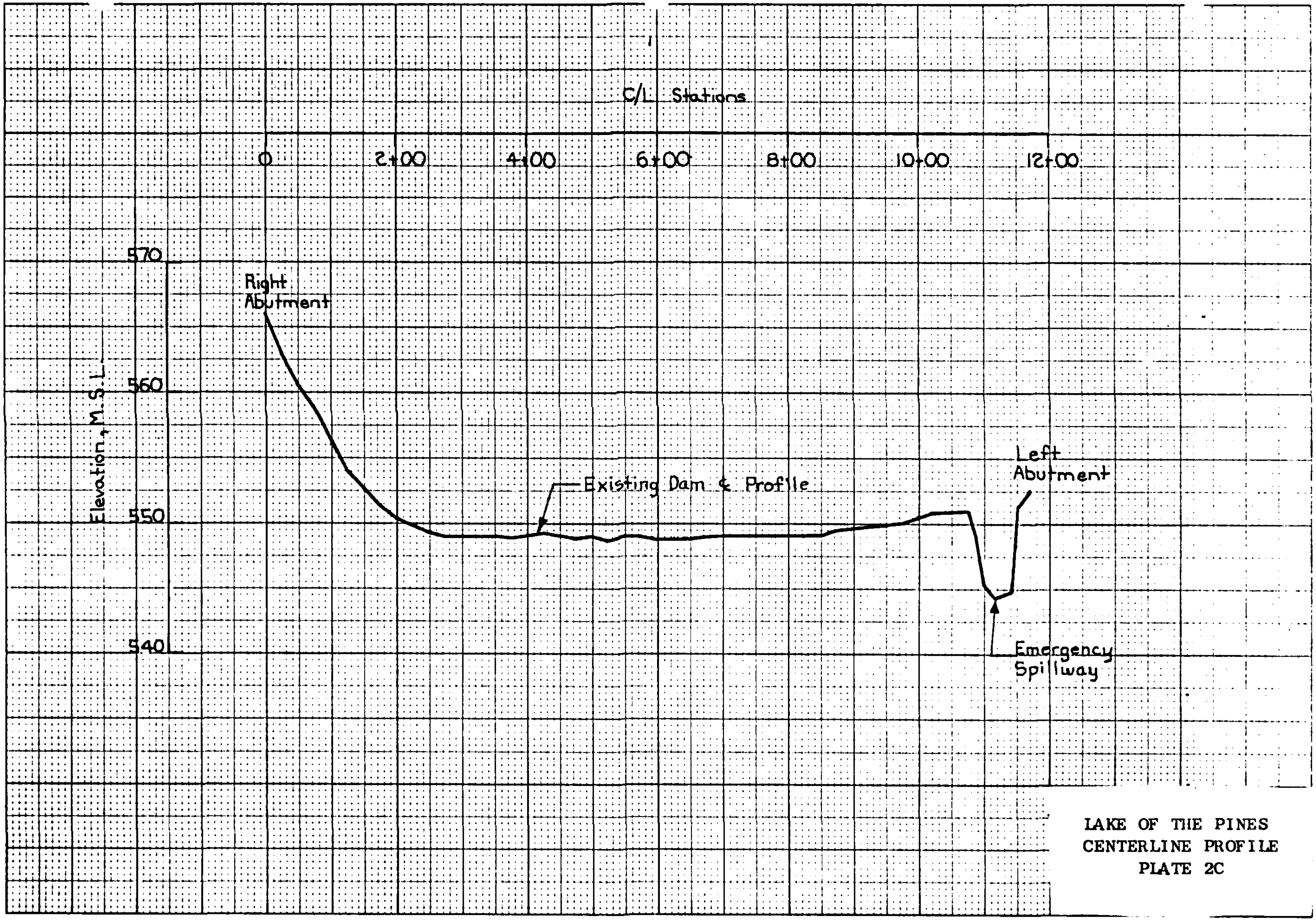
LAKE JULIA
CENTERLINE PROFILE
PLATE 2B



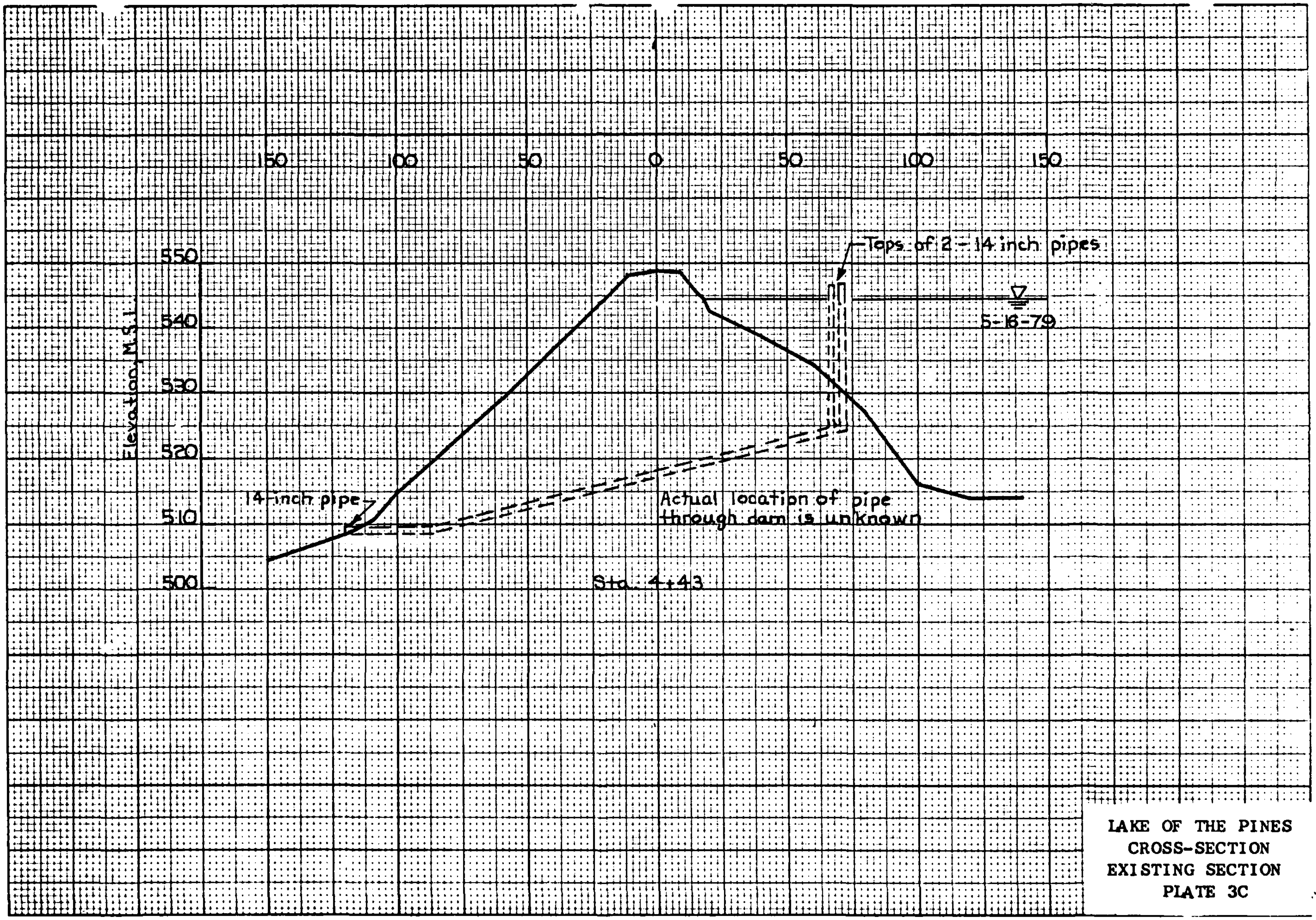
LAKE JULIA
CROSS-SECTION
EXISTING CONDITION
PLATE 3B



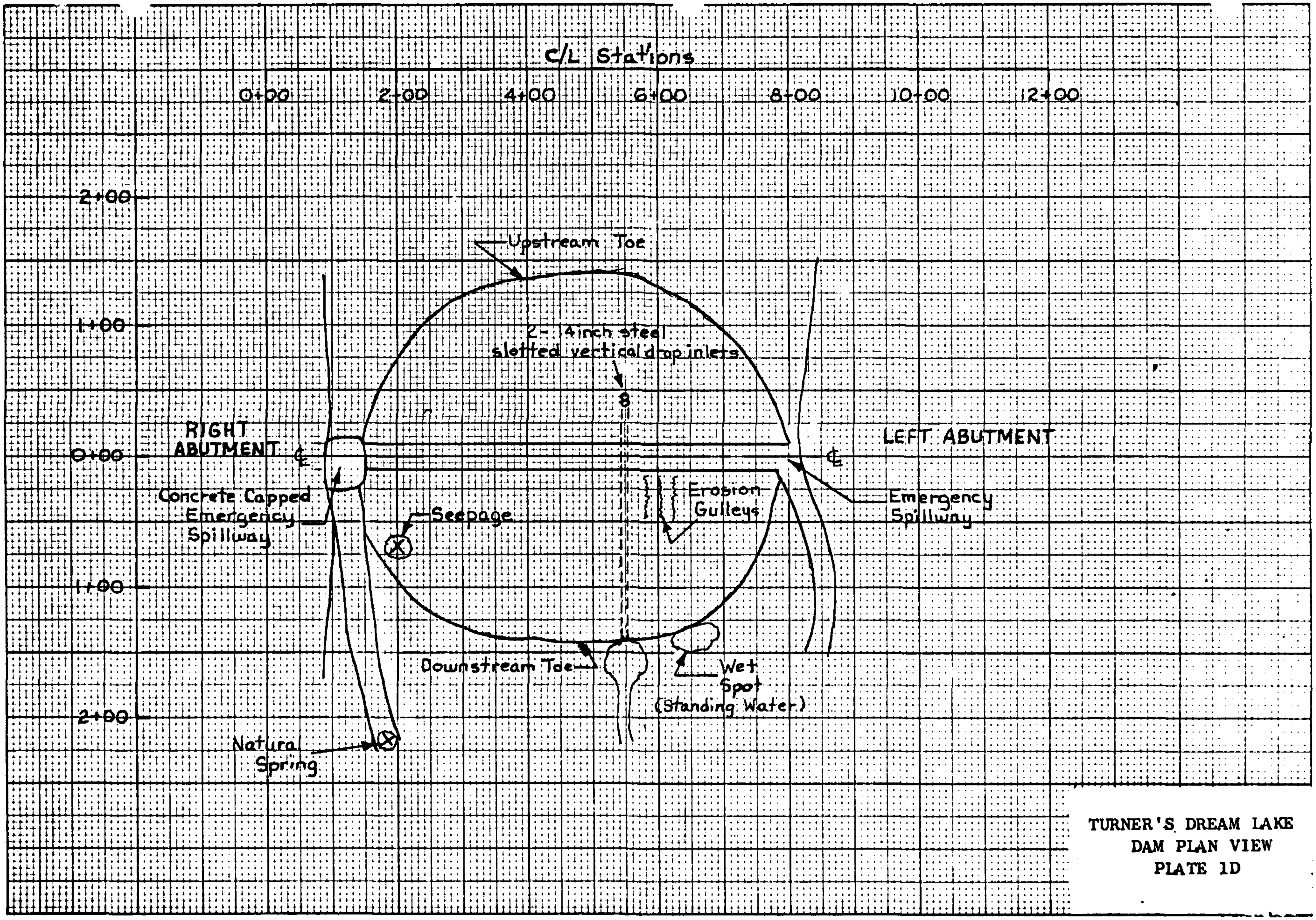
LAKE OF THE PINES
DAM PLAN VIEW
PLATE 1C



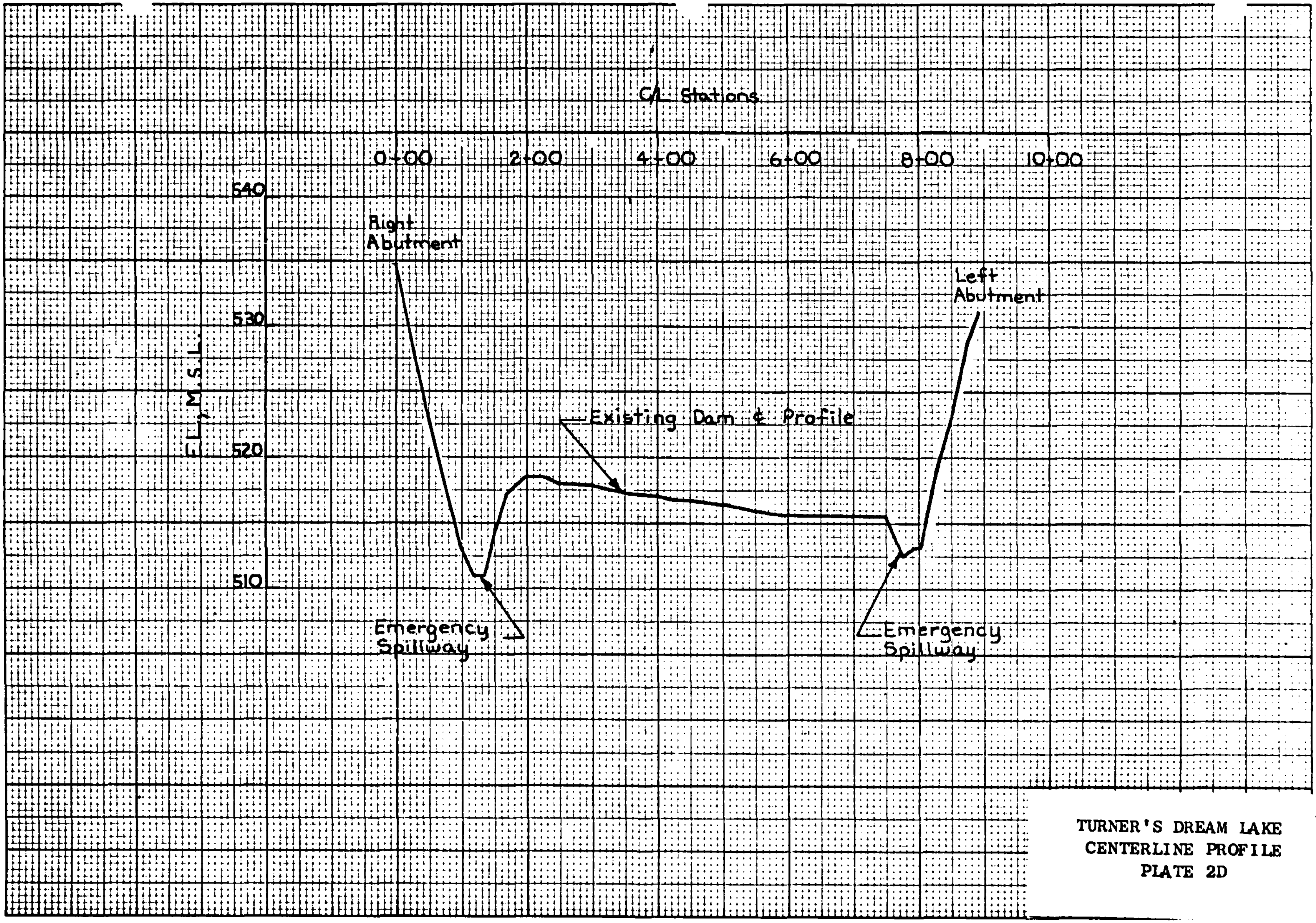
LAKE OF THE PINES
CENTERLINE PROFILE
PLATE 2C



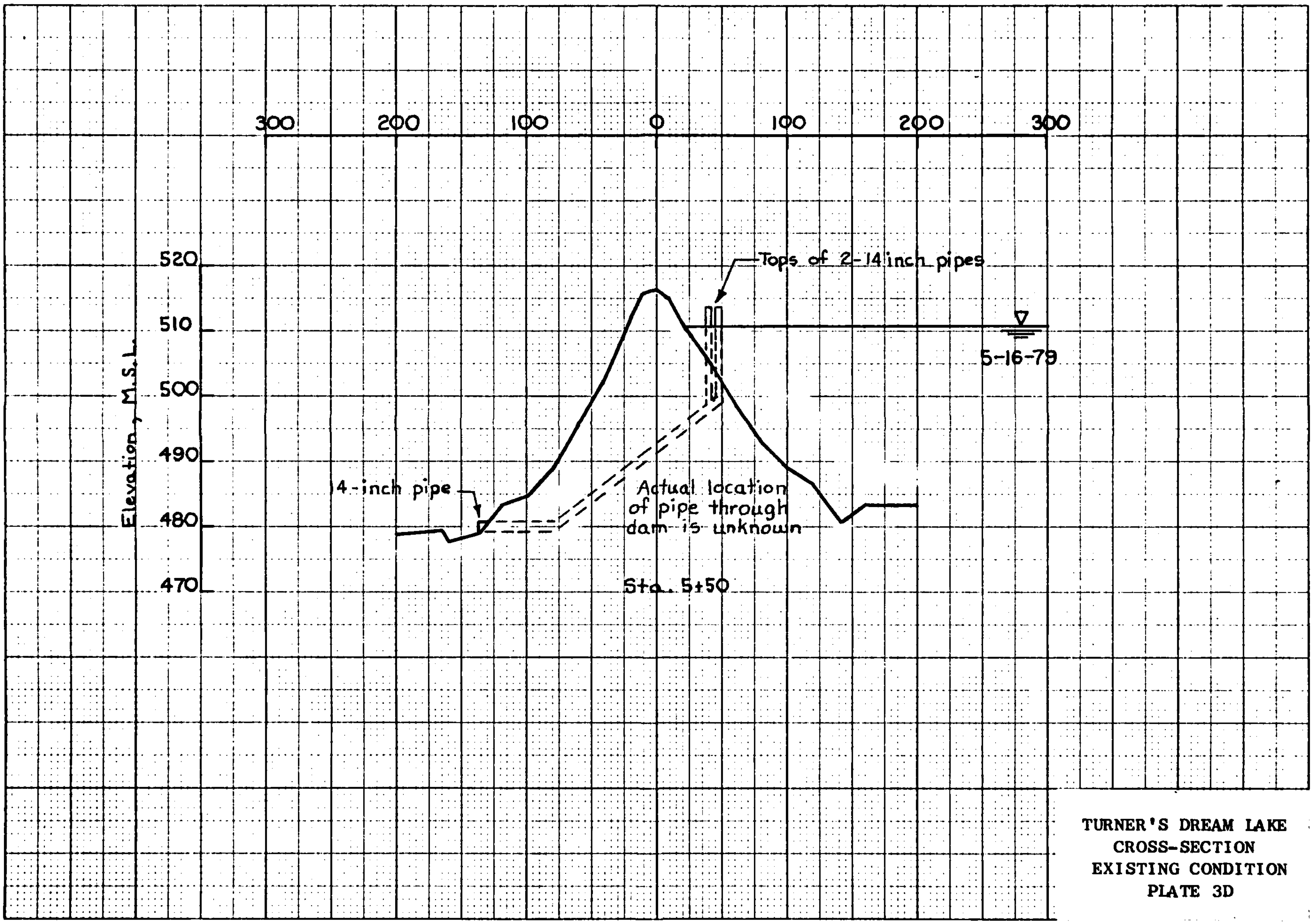
LAKE OF THE PINES
CROSS-SECTION
EXISTING SECTION
PLATE 3C



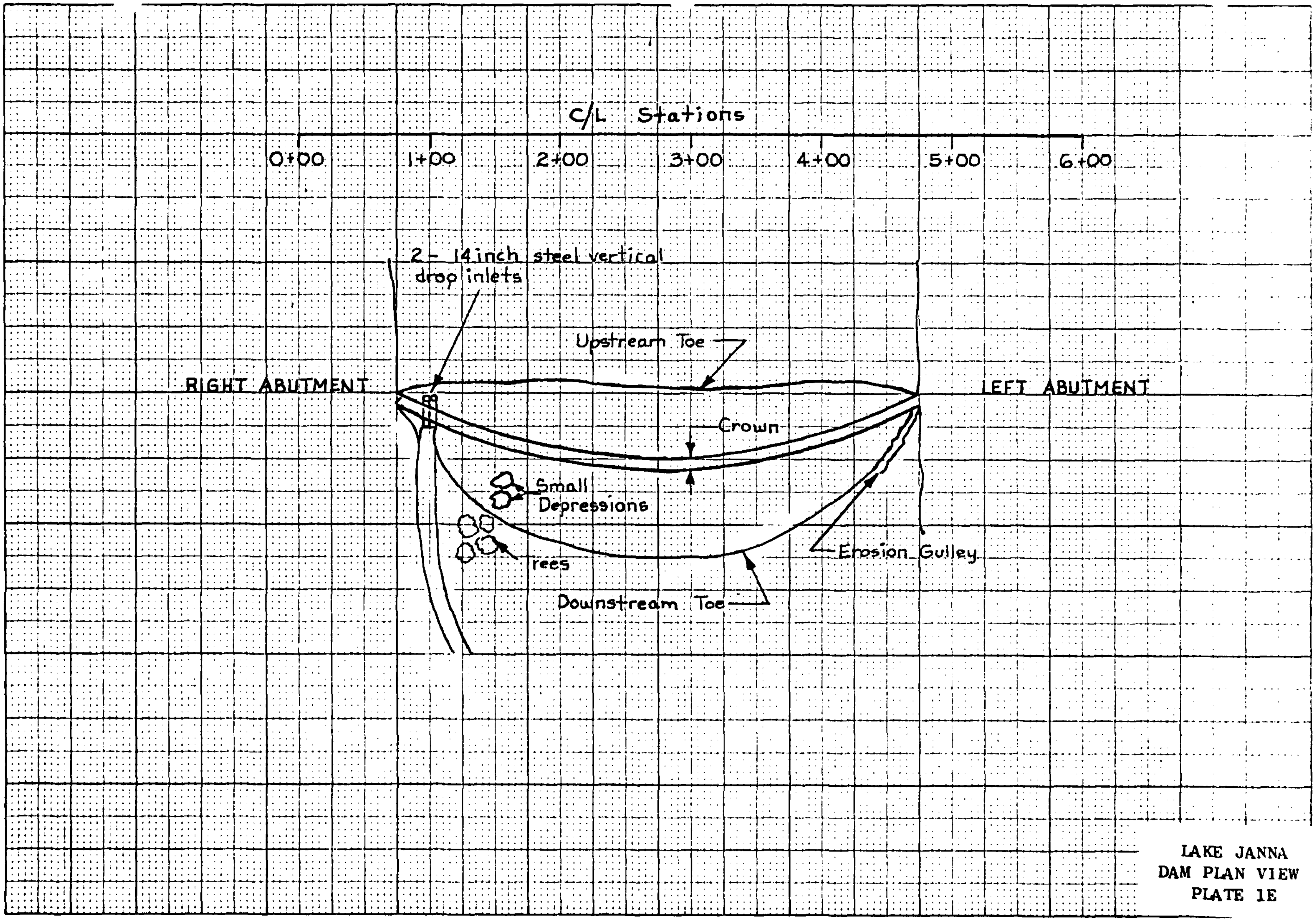
TURNER'S DREAM LAKE
DAM PLAN VIEW
PLATE 1D



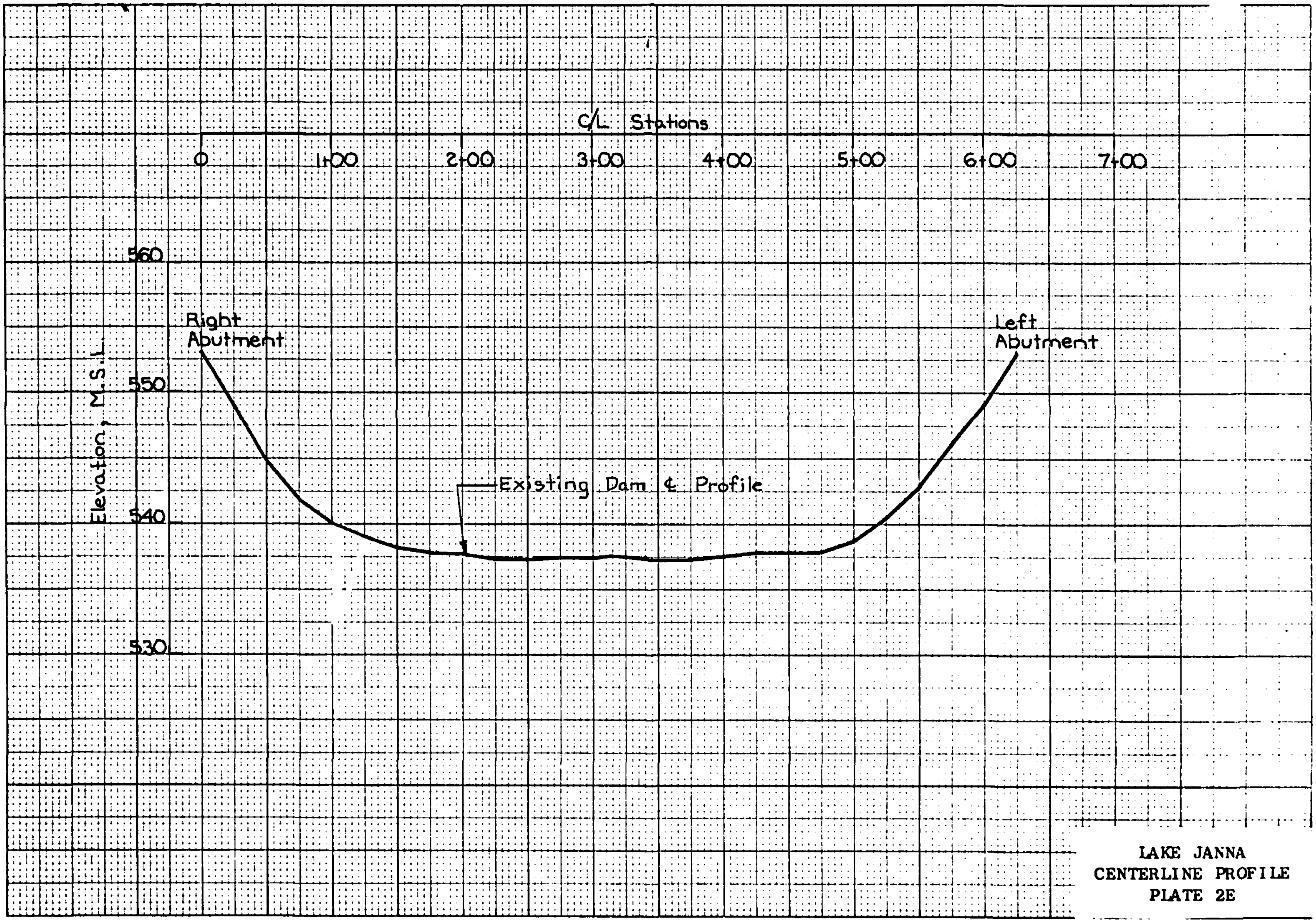
TURNER'S DREAM LAKE
CENTERLINE PROFILE
PLATE 2D



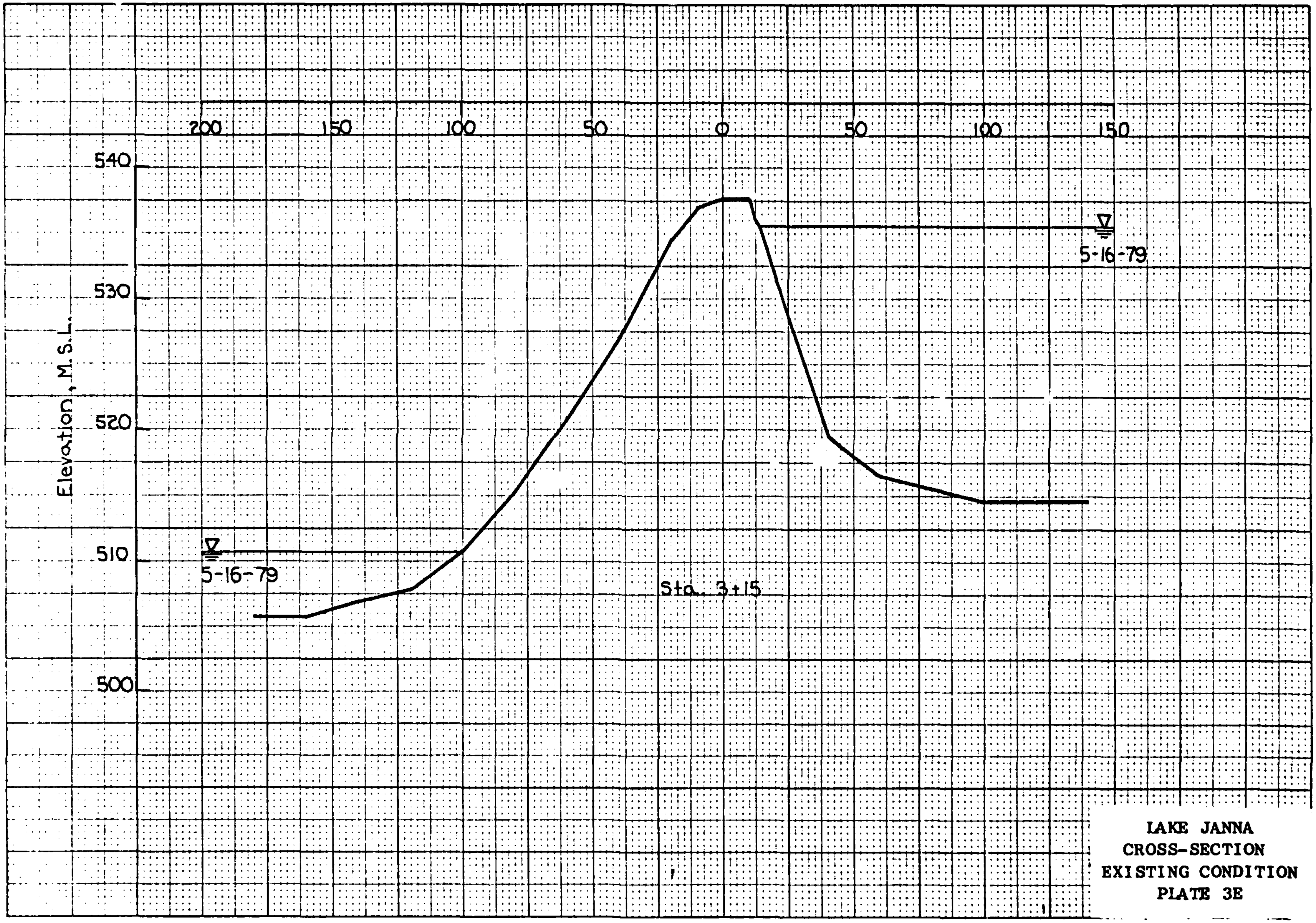
TURNER'S DREAM LAKE
CROSS-SECTION
EXISTING CONDITION
PLATE 3D



LAKE JANNA
DAM PLAN VIEW
PLATE 1E



LAKE JANNA
CENTERLINE PROFILE
PLATE 2E



LAKE JANNA
CROSS-SECTION
EXISTING CONDITION
PLATE 3E

LAKE JULIA

PHOTO 1B: Overview of Lake and Dam

PHOTO 2B: Upstream Embankment

PHOTO 3B: Downstream Embankment

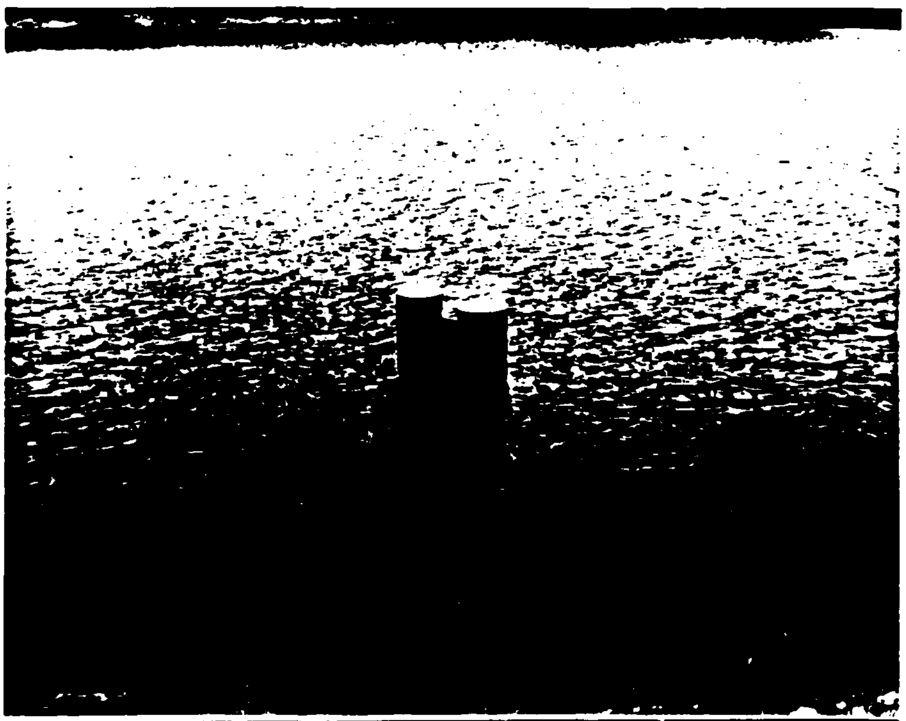


PHOTO 4B: Inlet of Vertical Discharge

PHOTO 5B: Emergency Spillway

PHOTO 6B: Wavewash on Upstream Embankment

PHOTO 7B: Erosion Gulley in Upstream Embankment near Left Abutment

PHOTO 8B: Erosion Gulley in Downstream Embankment near Left Abutment

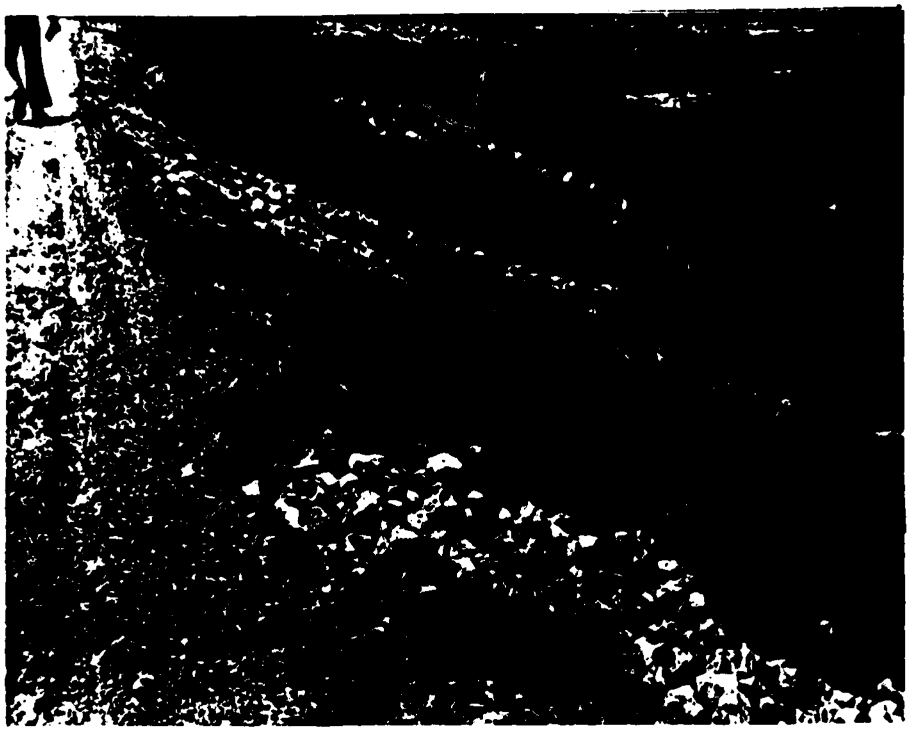


PHOTO 9B: Repaired Erosion Gulleys at Dam Crest

LAKE OF THE PINES

PHOTO 1C: Overview of Lake and Dam

PHOTO 2C: Upstream Embankment

PHOTO 3C: Downstream Embankment

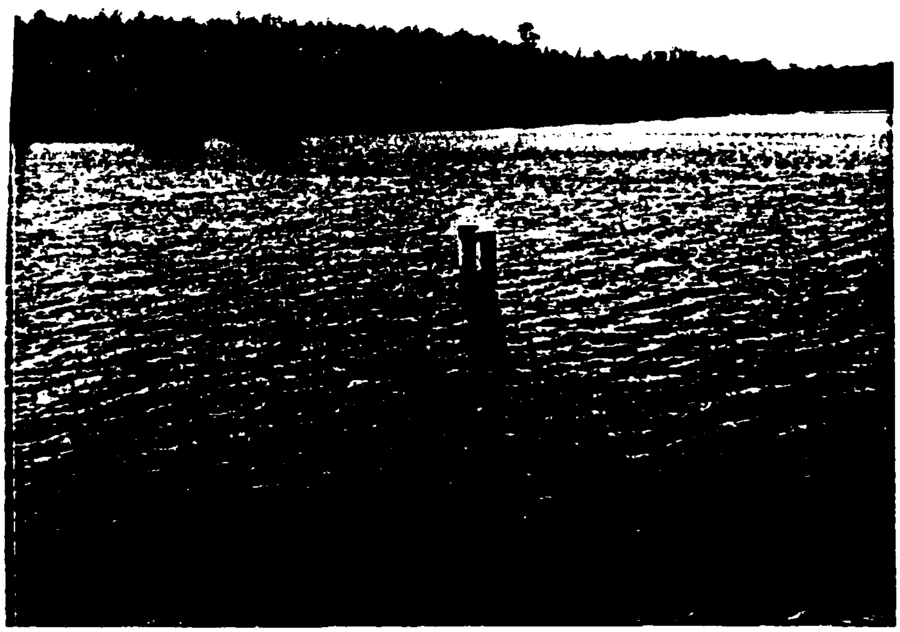


PHOTO 4C: Inlet of Vertical Discharge

PHOTO 5C: Outlet of Vertical Discharge

PHOTO 6C: Emergency Spillway

PHOTO 7C: Spillway Outfall Channel

PHOTO 8C: Seepage at Downstream Toe

PHOTO 9C: Seepage Near Left Abutment

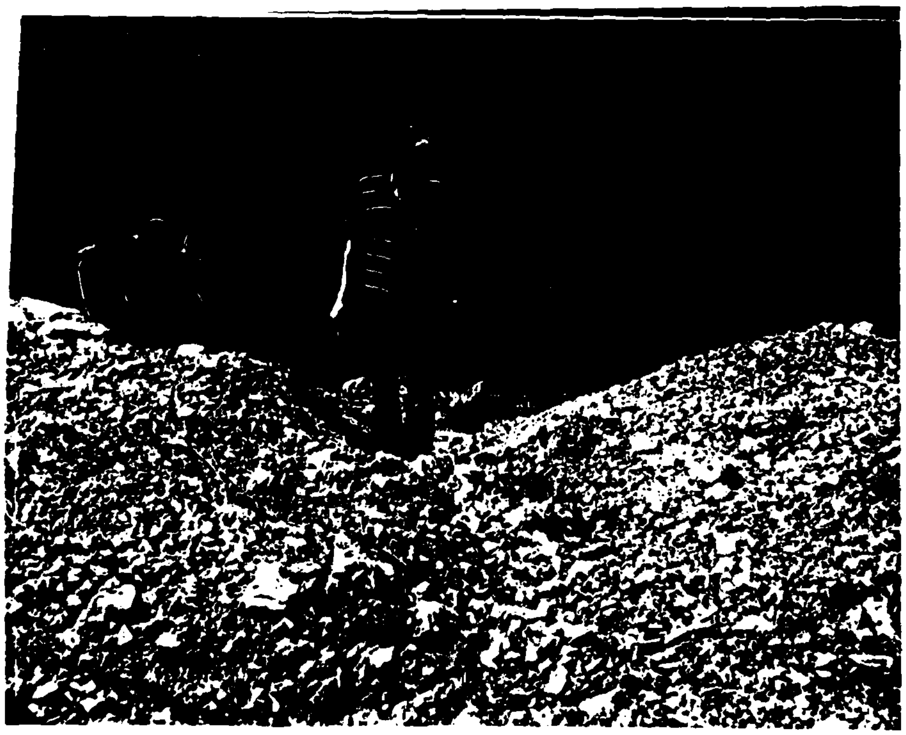


PHOTO 10C: Erosion on Upstream Embankment near Left Abutment

PHOTO 11C: Erosion on Downstream Embankment near Right Abutment

PHOTO 12C: Landside Ditch in Right Abutment

TURNER'S DREAM LAKE

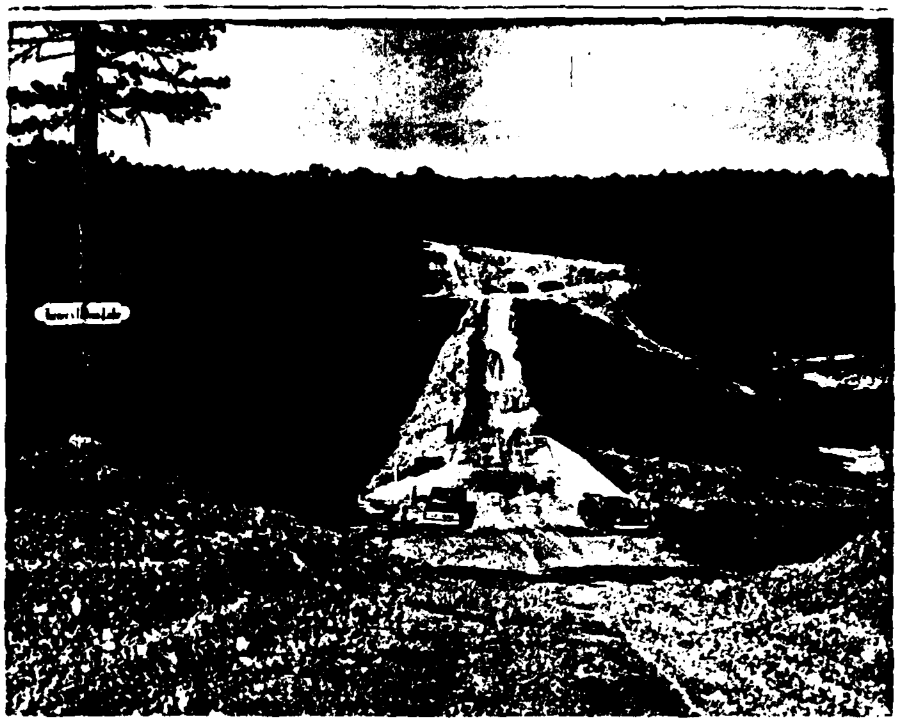


PHOTO 1D: Overview of Lake and Dam

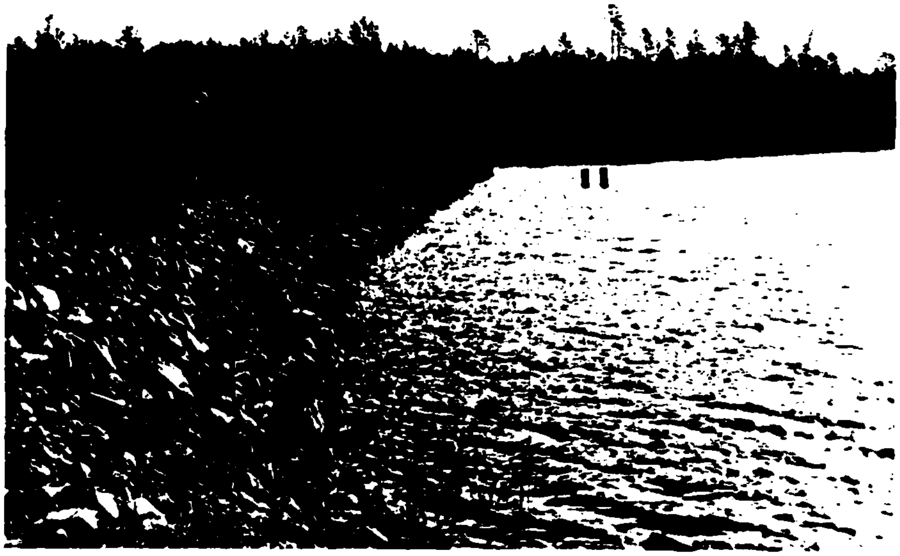


PHOTO 2D: Upstream Embankment

PHOTO 3D: Downstream Embankment

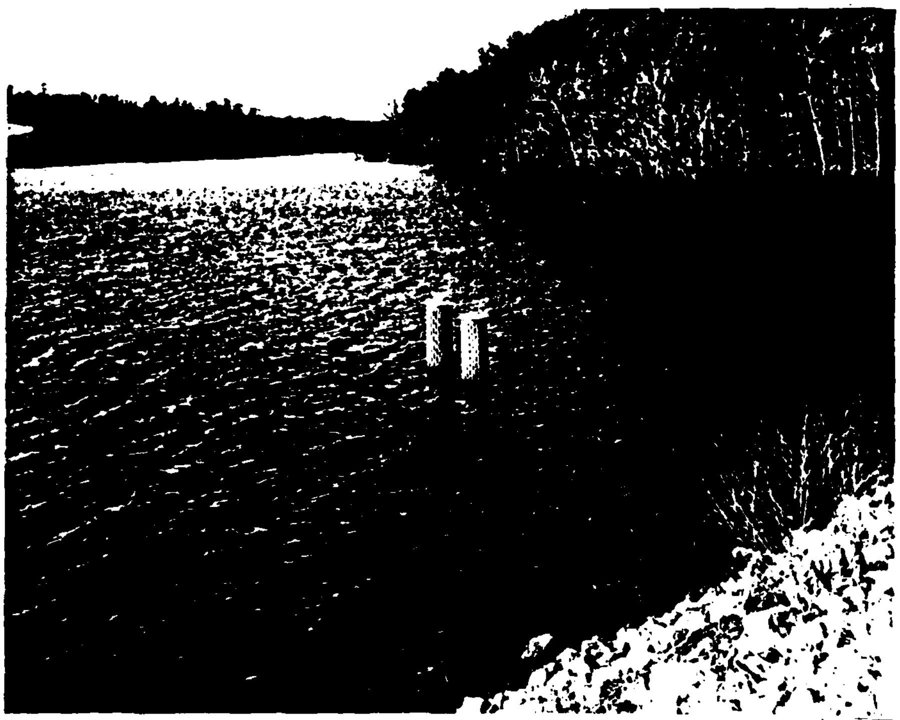


PHOTO 4D: Inlet of Vertical Discharge

PHOTO 5D: Outlet of Discharge Structure

PHOTO 6D: Principal Outlet Channel

PHOTO 7D: Right Abutment Spillway

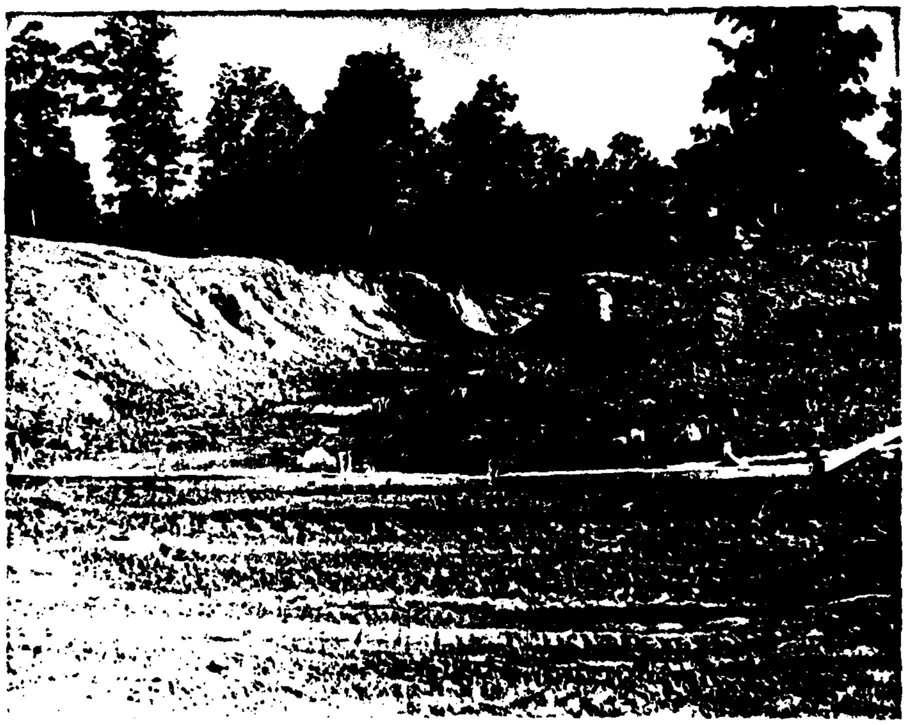


PHOTO 8D: Left Abutment Spillway

PHOTO 9D: Erosion on Downstream Embankment near Dam Crest

PHOTO 10D: Seepage in Right Abutment

PHOTO 11D: Spring Downstream of Right Abutment

PHOTO 12D: Wet Spot at Toe of Dam

PHOTO 13D: Landside Toe of Dam

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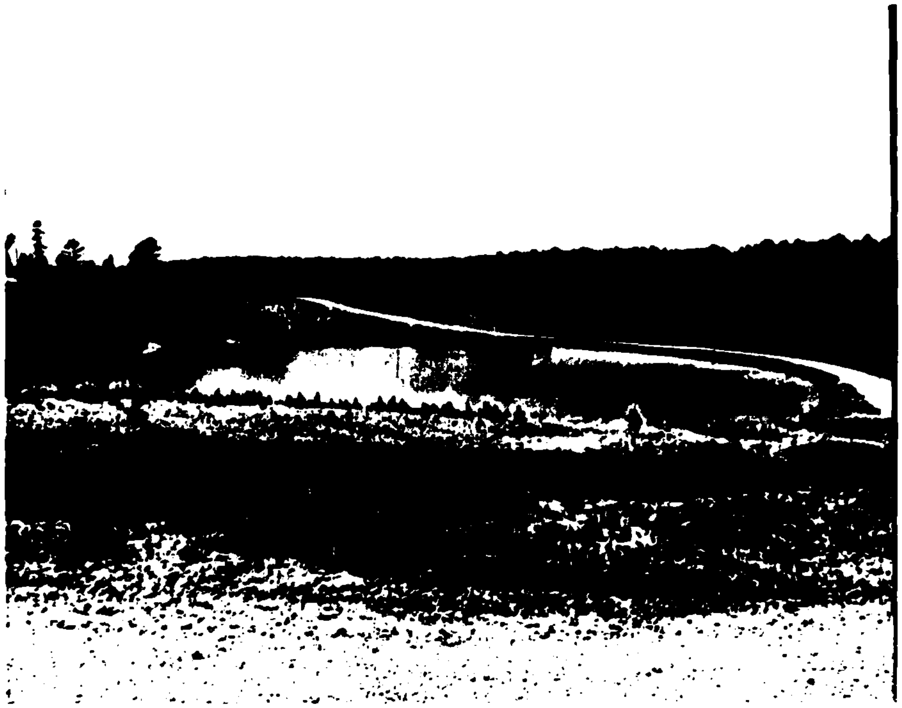


PHOTO 1E: Overview of Lake and Dam

PHOTO 2E: Upstream Embankment

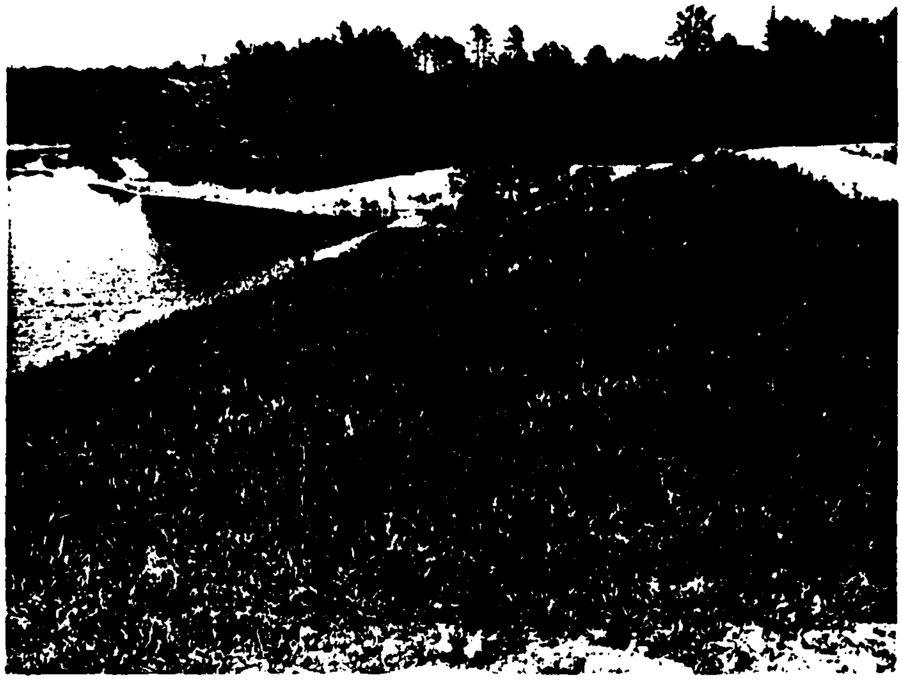


PHOTO 3E: Downstream Embankment

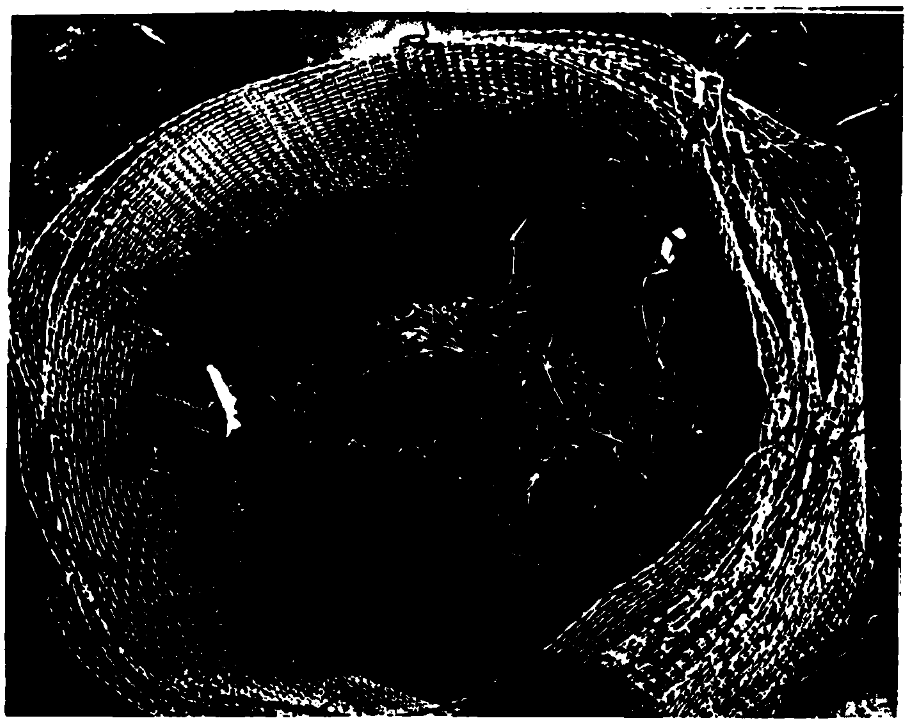


PHOTO 4E: Inlet of Vertical Discharge

PHOTO 5E: Discharge of Vertical Structure

PHOTO 6E: Outlet Channel

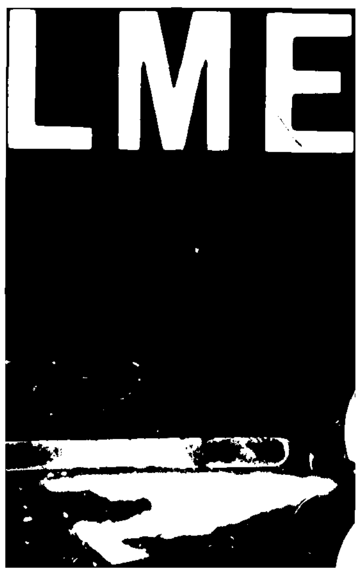
PHOTO 7E: Erosion Gulley in Downstream Embankment at Left Abutment

PHOTO 8E: Erosion Gulley on Downstream Embankment

AFFECTED DOWNSTREAM FEATURES

PHOTO 1F: Dwellings Downstream of Turkey Creek Dams

PHOTO 2F: Dwellings Downstream of Turkey Creek Dams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